LOS VAQUEROS

A Water Quality and Resource Management Project
Sponsored by
Contra Costa Water District

Stage 2 EIR/EIS Technical Report

Lead Agencies:

Contra Costa Water District
Concord, California

U.S. Department of the Interior
Bureau of Reclamation, Mid-Pacific Region
Sacramento, California

Technical Assistance Provided by:

Jones & Stokes Associates, Inc.
James M. Montgomery, Consulting Engineers, Inc.
Woodward-Clyde Consultants
Sonoma State University

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Introduction

This Stage 2 EIR/EIS Technical Report contains background information for the analyses contained in the Stage 2 EIR/EIS.

The report is divided into four sections. These four sections are:

- Section A. Project Description,
- Section B. Delta System Resources,
- Section C. Terrestrial Biology, and
- Section D. Analyses Background, Methodology, and Assumptions.

Each of these sections is further divided into additional sections that provide specific information in support of various analyses contained in the Stage 2 EIR/EIS. Complete citations referenced in this technical report are included in the Stage 2 EIR/EIS in Chapter 21, "Citations".

Table of Contents

Section D. Analyses Background, Assumptions, and Methodologies

Section A

Project Description

Section A-1. Detailed Costs of the Project Alternatives

Table 1. Los Vaqueros Reservoir Alternative Costs
(Costs in 1988 Dollars)

	Cost	Property	Subtotal	Contingency	Total
			Rock Slough/Old River No. 1 Configuration		
DAM FACILITY, FACILITY RELOCATIONS, LAND, ADMINISTRATIVE, AND CONSULTANT COSTS					
* Dam and Appurtenant Facilities			$57,254,000	$10,422,000	$67,676,000
* Vasco Road Relocation			26,495,000	6,167,000	32,662,000
* Utility Relocation			21,041,000	3,078,000	24,119,000
* Engineering/Legal/Admin					70,000,000
* Watershed/Utility/Vasco Rd. Land					47,836,000
Subtotal					$242,293,000
PUMPING & INTAKE FACILITIES					
* Old River Pumping Plant	$10,640,000	$34,000	$10,674,000	$2,128,000	$12,802,000
* Transfer Pumping Plant	11,040,000		11,040,000	2,208,000	13,248,000
* Fish Facilities (Old River)	1,475,000		1,475,000	368,750	1,844,000
* Chloramination Facilities	85,000		85,000	21,250	106,000
* Neroly Blending Basin	206,000	444,000	650,000	51,500	703,000
* Transfer Reservoir	997,000		997,000	199,400	1,196,000
* Access Road to Pumping Plant			647,000	161,750	909,000
Subtotal					$30,707,000
PIPELINES					
* Old River Pipeline	$15,200,000	$327,000	$15,527,000	$3,040,000	$18,567,000
* Foundation Treatment (OR Pipeline)	4,356,000		4,356,000	1,089,000	5,445,000
* Transfer Pipeline	5,187,500		5,187,500	1,037,500	6,225,000
* LV/Neroly Pipeline	21,580,000	2,860,000	24,440,000	4,316,000	28,756,000
* Pigging Facilities	598,000		598,000	119,600	717,600
Subtotal					$59,711,000
Project Contingency					$13,269,000
TOTAL					$345,980,000
ANNUAL OPERATIONS & MAINTENANCE COSTS					$2,698,000

Table 1. Continued

	Cost	Property	Subtotal	Contingency	Total
			Rock Slough/Old River No. 2 Configuration		
DAM FACILITY, FACILITY RELOCATIONS, LAND, ADMINISTRATIVE, AND CONSULTANT COSTS					
* Dam and Appurtenant Facilities			$57,254,000	$10,422,000	$67,676,000
* Vasco Road Relocation			26,495,000	6,167,000	32,662,000
* Utility Relocation			21,041,000	3,078,000	24,119,000
* Engineering/Legal/Admin					70,000,000
* Watershed/Utility/Vasco Rd. Land					47,548,000
Subtotal					$242,005,000
PUMPING & INTAKE FACILITIES					
* Old River Pumping Plant	$9,900,000	$34,000	$9,934,000	$1,980,000	$11,914,000
* Transfer Pumping Plant	12,240,000		12,240,000	2,448,000	14,688,000
* Fish Facilities (Old River)	1,475,000		1,475,000	368,750	1,844,000
* Chloramination Facilities	85,000		85,000	21,250	106,000
* Neroly Blending Basin	206,000	444,000	650,000	51,500	702,000
* Transfer Reservoir	997,000	100,000	1,097,000	199,400	1,296,000
Subtotal					$30,550,000
PIPELINES					
* Old River Pipeline	$21,200,000	$515,000	$21,715,000	$4,240,000	$25,955,000
* Foundation Treatment (OR Pipeline)	3,388,000		3,388,000	847,000	4,235,000
* Transfer Pipeline	15,147,500		15,147,500	3,029,500	18,177,000
* LV/Neroly Pipeline	11,620,000	2,860,000	14,480,000	2,324,000	16,804,000
* Pigging Facilities	598,000		598,000	119,600	718,000
Subtotal					$65,889,000
Project Contingency					$13,506,000
TOTAL					$351,950,000
ANNUAL OPERATIONS & MAINTENANCE COSTS					$2,807,000

Table 1. Continued

	Cost	Property	Subtotal	Contingency	Total
Rock Slough/Old River No. 3 Configuration					
DAM FACILITY, FACILITY RELOCATIONS, LAND, ADMINISTRATIVE, AND CONSULTANT COSTS					
* Dam and Appurtenant Facilities			$57,254,000	$10,422,000	$67,676,000
* Vasco Road Relocation			26,495,000	6,167,000	32,662,000
* Utility Relocation			21,041,000	3,078,000	24,119,000
* Engineering/Legal/Admin					70,000,000
* Watershed/Utility/Vasco Rd. Land					47,744,000
Subtotal					$242,201,000
PUMPING & INTAKE FACILITIES					
* Old River Pumping Plant	$9,900,000	$34,000	$9,934,000	$1,980,000	$11,914,000
* Transfer Pumping Plant	12,240,000		12,240,000	2,448,000	14,688,000
* Fish Facilities (Old River)	1,475,000		1,475,000	368,750	1,844,000
* Chloramination Facilities	85,000		85,000	21,250	106,000
* Neroly Blending Basin	206,000	444,000	650,000	51,500	702,000
* Transfer Reservoir	997,000	100,000	1,097,000	199,400	1,296,000
Subtotal					$30,550,000
PIPELINES					
* Old River Pipeline	$20,400,000	$319,000	$20,719,000	$4,080,000	$24,799,000
* Buttress Levees	7,000,000		7,000,000	1,400,000	8,400,000
* Foundation Treatment (OR Pipeline)	6,292,000		6,292,000	1,573,000	7,865,000
* Transfer Pipeline	15,147,500		15,147,500	3,029,500	18,177,000
* LV/Neroly Pipeline	11,620,000	2,860,000	14,480,000	2,324,000	16,804,000
* Werner Dredger Cut Crossing	4,000,000		4,000,000	800,000	4,800,000
* Pigging Facilities	598,000		598,000	119,600	718,000
Subtotal					$81,563,000
Project Contingency					$14,166,000
TOTAL					$368,480,000
ANNUAL OPERATIONS & MAINTENANCE COSTS					$2,929,000

Table 1. Continued

	Cost	Property	Subtotal	Contingency	Total
			Rock Slough/Old River No. 4 Configuration		
DAM FACILITY, FACILITY RELOCATIONS, LAND, ADMINISTRATIVE, AND CONSULTANT COSTS					
* Dam and Appurtenant Facilities			$57,254,000	$10,422,000	$67,676,000
* Vasco Road Relocation			26,495,000	6,409,000	32,904,000
* Utility Relocation			21,041,000	3,142,000	24,183,000
* Access Road			508,000	101,600	610,000
* Engineering/Legal/Admin					70,000,000
* Watershed/Utility/Vasco Rd. Land					47,801,000
Subtotal					$243,174,000
PUMPING & INTAKE FACILITIES					
* Old River Pumping Plant	$9,900,000	$34,000	$9,934,000	$1,980,000	$11,914,000
* Transfer Pumping Plant	12,240,000		12,240,000	2,448,000	14,688,000
* Fish Facilities (Old River)	1,475,000		1,475,000	368,750	1,844,000
* Chloramination Facilities	85,000		85,000	21,250	106,000
* Neroly Blending Basin	206,000	444,000	650,000	51,500	702,000
* Transfer Reservoir	997,000	100,000	1,097,000	199,400	1,296,000
Subtotal					$30,550,000
PIPELINES					
* Old River Pipeline	$19,200,000	$262,000	$19,462,000	$3,840,000	$23,302,000
* Buttress Levees	7,000,000		7,000,000	1,400,000	8,400,000
* Foundation Treatment (OR Pipeline)	5,808,000		5,808,000	1,452,000	7,260,000
* Transfer Pipeline	15,147,500		15,147,500	3,029,500	18,177,000
* LV/Neroly Pipeline	11,620,000	2,860,000	14,480,000	2,324,000	16,804,000
* Werner Dredger Cut Crossing	4,000,000		4,000,000	800,000	4,800,000
* Pigging Facilities	598,000		598,000	119,600	718,000
Subtotal					$79,461,000
Project Contingency					$14,105,000
TOTAL					$367,290,000
ANNUAL OPERATIONS & MAINTENANCE COSTS					$2,913,000

Table 1. Continued

	Cost	Property	Subtotal	Contingency	Total
Rock Slough/Old River No. 5 Configuration					
DAM FACILITY, RELOCATION, LAND, ADMINISTRATIVE, AND CONSULTANT COSTS					
* Dam and Appurtenant Facilities			$57,254,000	$10,422,000	$67,676,000
* Vasco Road Relocation			26,495,000	6,167,000	32,662,000
* Utility Relocation			21,041,000	3,078,000	24,119,000
* Engineering/Legal/Admin					70,000,000
* Watershed/Utility/Vasco Rd. Land					47,625,000
Subtotal					$242,082,000
PUMPING & INTAKE FACILITIES					
* Old River Pumping Plant	$10,260,000	$34,000	$10,294,000	$2,052,000	$12,346,000
* Transfer Pumping Plant	11,040,000		11,040,000	2,208,000	13,248,000
* Fish Facilities (Old River)	1,475,000		1,475,000	368,750	1,844,000
* Chloramination Facilities	85,000		85,000	21,250	106,000
* Neroly Blending Basin	206,000	444,000	650,000	51,500	702,000
* Transfer Reservoir	997,000	50,000	1,047,000	199,400	1,246,000
Subtotal					$29,492,000
PIPELINES					
* Old River Pipeline	$13,600,000	$488,000	$14,088,000	$2,720,000	$16,808,000
* Foundation Treatment (OR Pipeline)	3,388,000		3,388,000	847,000	4,235,000
* Transfer Pipeline	9,545,000		9,545,000	1,909,000	11,454,000
* LV/Neroly Pipeline	18,260,000	2,860,000	21,120,000	3,652,000	24,772,000
* Pigging Facilities	598,000		598,000	119,600	718,000
Subtotal					$57,987,000
Project Contingency					$13,139,000
TOTAL					$342,700,000
ANNUAL OPERATIONS & MAINTENANCE COSTS					$2,673,000
Rock Slough/Old River No. 6 Configuration					
DAM FACILITY, RELOCATION, LAND, ADMINISTRATIVE, AND CONSULTANT COSTS					
* Dam and Appurtenant Facilities			$57,254,000	$10,422,000	$67,676,000

Table 1. Continued

	Cost	Property	Subtotal	Contingency	Total
* Vasco Road Relocation			26,495,000	6,167,000	32,662,000
* Utility Relocation			21,041,000	3,078,000	24,119,000
* Engineering/Legal/Admin					70,000,000
* Watershed/Utility/Vasco Rd. Land					47,510,000
Subtotal					$241,967,000
PUMPING & INTAKE FACILITIES					
* Old River Pumping Plant	$10,260,000	$34,000	$10,294,000	$2,052,000	$12,346,000
* Transfer Pumping Plant	11,040,000		11,040,000	2,208,000	13,248,000
* Fish Facilities (Old River)	1,475,000		1,475,000	368,750	1,844,000
* Chloramination Facilities	85,000		85,000	21,250	106,000
* Neroly Blending Basin	206,000	444,000	650,000	51,500	702,000
* Transfer Reservoir	997,000	50,000	1,047,000	199,400	1,246,000
Subtotal					$29,492,000
PIPELINES					
* Old River Pipeline	$16,800,000	$603,000	$17,403,000	$3,360,000	$20,763,000
* Foundation Treatment (OR Pipeline)	7,744,000		7,744,000	1,936,000	9,680,000
* Transfer Pipeline	9,545,000		9,545,000	1,909,000	11,454,000
* LV/Neroly Pipeline	18,260,000	2,860,000	21,120,000	3,652,000	24,772,000
* Pigging Facilities	598,000		598,000	119,600	718,000
Subtotal					$67,387,000
Project Contingency					$13,514,000
TOTAL					$352,360,000
ANNUAL OPERATIONS & MAINTENANCE COSTS					$2,714,000

Rock Slough/Clifton Court Forebay Configuration

	Cost	Property	Subtotal	Contingency	Total
DAM FACILITY, RELOCATION, LAND, ADMINISTRATIVE, AND CONSULTANT COSTS					
* Dam and Appurtenant Facilities			$57,254,000	$10,422,000	$67,676,000
* Vasco Road Relocation			26,495,000	6,167,000	32,662,000
* Utility Relocation			21,041,000	3,078,000	24,119,000
* Clifton Court Buy-in Costs			8,600,000	2,580,000	11,180,000
* Engineering/Legal/Admin					70,000,000

Table 1. Continued

	Cost	Property	Subtotal	Contingency	Total
* Watershed/Utility/Vasco Rd. Land					47,971,000
Subtotal					$253,608,000
PUMPING & INTAKE FACILITIES					
* Clifton Court Pumping Plant	$10,260,000	$34,000	$10,294,000	$2,052,000	$12,346,000
* Transfer Pumping Plant	11,040,000		11,040,000	2,208,000	13,248,000
* Fish Facilities (Old River)	1,475,000		1,475,000	368,750	1,844,000
* Chloramination Facilities	85,000		85,000	21,250	106,000
* Neroly Blending Basin	206,000	444,000	650,000	51,500	702,000
* Transfer Reservoir	997,000		997,000	199,400	1,196,000
Subtotal				SUBTOTAL	$29,442,000
PIPELINES					
* Clifton Court Forebay Pipeline	$8,920,000	$192,000	$9,112,000	$1,784,000	$10,896,000
* Transfer Pipeline	5,187,500		5,187,500	1,037,500	6,225,000
* LV/Neroly Pipeline	21,580,000	2,860,000	24,440,000	4,316,000	28,756,000
* Clifton Court Intake Channel	84,000		84,000	21,000	105,000
* Pigging Facilities	598,000		598,000	119,600	718,000
Subtotal					$46,700,000
Project Contingency					$10,920,000
TOTAL					$340,670,000
ANNUAL OPERATIONS & MAINTENANCE COSTS					$2,641,000

Note: The project contingency is based on 5% of project costs excluding other contingencies, and other sunk costs for land, engineering, administration, and legal services as of June 1990.

Table 2. Kellogg Reservoir Alternative Costs
(Costs in 1988 Dollars)

	Cost	Property	Subtotal	Contingency	Total
DAM FACILITY, FACILITY RELOCATIONS, LAND, ADMINISTRATIVE, AND CONSULTANT COSTS					
• Dam and Appurtenant Facilities			$104,180,000	$30,316,380	$134,496,000
• Vasco Road Relocation			26,495,000	6,167,000	32,662,000
• Utility Relocation			12,413,000	1,860,000	14,273,000
• Engineering/Legal/Admin					83,273,000
• Watershed/Utility/Vasco Rd. Land					47,625,000
Subtotal					312,329,000
PUMPING & INTAKE FACILITIES					
• Old River Pumping Plant	$10,260,000	$34,000	$10,294,000	$2,052,000	$12,346,000
• Transfer Pumping Plant	4,710,000		4,710,000	942,000	5,652,000
• Fish Facilities (Old River)	1,475,000		1,475,000	368,750	1,844,000
• Chloramination Facilities	85,000		85,000	21,250	106,000
• Neroly Blending Basin	206,000	444,000	650,000	51,500	702,000
• Transfer Reservoir	997,000	50,000	1,047,000	199,400	1,246,000
Subtotal					21,896,000
PIPELINES					
• Old River Pipeline	$13,600,000	$488,000	$14,088,000	$2,720,000	$16,808,000
• Transfer Pipeline	1,743,000		1,743,000	348,600	2,092,000
• Kellogg/Neroly Pipeline	18,260,000	$2,860,000	21,120,000	3,652,000	24,772,000
• Foundation Treatment-OR Pipeline	3,388,000		3,388,000	847,000	4,235,000
• Pigging Facilities	598,000		598,000	119,600	718,000
Subtotal					$48,625,000
Project Contingency					14,348,000
TOTAL					$397,198,000
ANNUAL OPERATIONS & MAINTENANCE COSTS					$2,248,000

Note: The project contingency is based on 5% of project costs excluding other contingencies, and other sunk costs for land, engineering, administration, and legal services as of June 1990.

Table 3. Desalination/EBMUD Emergency Supply Alternative Costs
(Costs in 1988 Dollars)

	Cost	Property	Subtotal	Contingency	Total
FACILITY, ADMINISTRATIVE, AND CONSULTANT COSTS					
* EBMUD Intertie - Mokelumne Connection Vault			$624,000	$156,000	$780,000
* Blending Facility			4,000,000	1,000,000	5,000,000
* Engineering/Legal/Admin					77,860,000
Subtotal					$83,640,000
PUMPING & INTAKE FACILITIES					
* Rock Slough Pumping Plants	$4,216,000		$4,216,000	$1,054,000	$5,270,000
* Pretreatment (Direct Filtration) Facilities	65,125,000	3,000,000	68,125,000	16,281,250	84,406,000
* Reverse Osmosis Plant & Appurtenant Facilities	150,000,000	$3,000,000	153,000,000	37,500,000	190,500,000
* EBMUD Intertie Connection at Pumping Plant	152,000		152,000	38,000	190,000
Subtotal					$280,366,000
PIPELINES					
* Waste Concentrate Pipeline	$13,061,000	$1,320,000	$14,381,000	$2,942,200	$17,323,000
* Rock Slough Canal Widening	4,067,000		4,067,000	813,400	4,880,000
* Rock Slough Pipeline	5,346,000	1,860,000	7,206,000	1,534,200	8,740,000
* EBMUD Intertie Pipeline	2,828,000	933,000	3,761,000	798,850	4,560,000
Subtotal					$35,503,000
Project Contingency					$16,871,000
TOTAL					$416,380,000
ANNUAL OPERATIONS & MAINTENANCE COSTS					$12,187,000

Note: The project contingency is based on 5% of project costs excluding other contingencies, and other sunck costs for land, engineering, administration, and legal services as of June 1990.

Table 4. Middle River Intake/EBMUD Emergency Supply Alternative Costs
(Costs in 1988 dollars)

	Cost	Property	Subtotal	Contingency	Total
FACILITY, ADMINISTRATIVE, AND CONSULTANT COSTS					
* Mokelumne Aqueduct Intertie			$1,086,000	$325,800	$1,412,000
* Access Facilities to Woodward Island			50,000	15,000	65,000
* Engineering/Legal/Admin					37,420,000
Subtotal					$38,897,000
PUMPING & INTAKE FACILITIES					
* Pumping Plant	$7,670,000	$34,000	$7,704,000	$1,534,000	$9,238,000
* Fish Facilities (Old River)	1,475,000		1,475,000	368,750	1,844,000
* Chloramination Facilities	85,000		85,000	21,250	106,000
* Neroly Facility	206,000	444,000	650,000	51,500	702,000
Subtotal					$11,890,000
PIPELINES					
* Middle River and EBMUD Pipeline	$23,360,000	$3,521,000	$26,881,000	$4,672,000	$31,553,000
* Buttress Levees	14,000,000		14,000,000	4,200,000	18,200,000
* Foundation Treatment-EBMUD Pipeline	6,292,000		6,292,000	1,573,000	7,865,000
* Foundation Treatment-Intake Pipeline	3,931,200		3,931,200	982,800	4,914,000
* Intake Suction Pipeline	3,416,400		3,416,400	683,280	4,100,000
* Old River Crossing	5,440,000		5,440,000	1,088,000	6,528,000
* Werner Dredger Cut Crossing	4,000,000		4,000,000	800,000	4,800,000
* Pigging Facilities	598,000		598,000	119,600	718,000
Subtotal					$78,678,000
Project Contingency					$5,650,000
TOTAL					$135,115,000
ANNUAL OPERATIONS & MAINTENANCE COSTS					$1,728,000

Note: The project contingency is based on 5% of project costs excluding other contingencies, and other sunk costs for land, engineering, administration, and legal services as of June 1990.

Section A-2. Recreation Development Guidelines for the Los Vaqueros Reservoir and Kellogg Reservoir Alternatives

Topic	Development Guidelines
Land use	
Grazing and dryland farming	Encourage compatible recreation use of grazing and agricultural lands by allowing recreation activities that would not require excessive conversion of grazing and agricultural land or exclusion of existing or proposed grazing and dryland farming operations.
Windfarms	Avoid siting recreation activity areas or facilities within 800 feet of windfarm areas. Restrict public access for recreation purposes in windfarm areas. Controlled public access through windfarm areas to other nonwindfarm areas may be allowed if off-road pedestrian activity is prohibited.
Residential	Avoid siting recreation use areas and facilities near residential sites. Restrict recreation-oriented public access in the vicinity of study area rural residences.
Utility lines	Design and coordinate recreation use areas and facilities so that they do not conflict with utility corridors.
Regional recreation	Coordinate study area recreation access, facilities, and activities in areas near Morgan Territory Regional Preserve and Round Valley Preserve with the East Bay Regional Park District (EBRPD).
Topography	Site major recreation facilities in watershed areas with slopes of 20% or less, when possible. Facility or building siting on slopes that are greater than 20% should be considered only under extreme circumstances.
Geology and seismicity	Conduct onsite geotechnical surveys prior to designing and constructing structurally oriented recreational facilities.
Soil erosion and landslides	Site major recreation facilities and buildings on slopes with a gradient of 20% or less. Grade sites and construct facilities using best management practices for avoiding soil erosion. Revegetate areas where vegetation cover is removed. Design and site trails and roads to avoid concentrating surface runoff. Avoid siting trails parallel to the slope gradient in moderate and severe erosion hazard areas, to reduce concentrated runoff along and downslope of trails. Minimize new road construction in moderate and severe erosion hazard areas. Refer to "Botanical Resources" section for erosion control guidelines.
Botanical resources	
Special-status species (general)	Avoid siting recreation activity areas or facilities in areas that could affect or result in loss of special-status species populations and the habitats on which they depend.

Topic	Development Guidelines
	Establish buffer zones around special-status plant populations. Permissible uses within buffer zones could include nonintensive recreation uses (e.g., hiking, birdwatching, nature walks, and picnicking). Intensive recreation uses and ground-disturbing activities such as facility siting should be avoided.
	Minimum buffer sizes should be established on a site-specific basis. For the purpose of recreation planning, a minimum buffer zone of 500 feet is recommended between special-status plant species populations and high-use facilities (e.g., concession stands, campgrounds, ballparks, golf courses, tennis courts, swimming facilities, and conference centers), unless natural or artificial features are present that protect the resource from the adjacent land use.
	A minimum buffer zone of 200 feet is recommended between populations and new roads and trails, unless natural or artificial features are present that protect the resource from the adjacent land use.
	Minimize soil erosion associated with facility siting near special-status species populations and use best management practices to ensure that erosion does not adversely affect special-status plant species.
	Fence special-status populations near high-use, intensive facilities.
	Confine use of bicycle and equestrian trails to designated areas, using control structures such as fencing, gates, and signs where appropriate.
San Joaquin spearscale	All general guidelines for special-status plant species apply.
	Locate facilities that generate runoff downslope from San Joaquin spearscale populations.
	Prevent facility runoff from entering San Joaquin spearscale populations by installing ditches or other systems, or by grading the facility so that water does not drain toward populations.
	Locate roads, trails, and paths so that the population is not separated from its upslope watershed. Install culverts or other features to allow the free passage of water.
Brittlescale	All general guidelines for special-status plant species apply. Refer to guidelines identified for the San Joaquin spearscale.

Topic	Development Guidelines
Stinkbells	All general guidelines for special-status plant species apply.
	Monitor stinkbells populations located near trails. If bulb collection, trampling, or other impacts occur, the populations should be fenced or otherwise restricted.
Diablo helianthella	All general guidelines for special-status plant species apply.
	Avoid activities that result in the loss of canopy cover (e.g., loss of oaks or other tree or shrub species that shade the helianthella) adjacent to the helianthella populations.
Mt. Diablo manzanita	No additional guidelines are recommended beyond the general guidelines.
Brewer's dwarf flax	All general guidelines for special-status plant species apply.
	Avoid recreation facility siting and activities that would result in soil erosion upslope from Brewer's dwarf flax populations.
Large-flowered fiddleneck (recovery sites)	Avoid siting high-use recreation facilities within a 500-foot buffer zone of the recovery site. Avoid locating new roads or trails within 200 feet of the recovery sites. Ensure that recovery sites are adequately fenced, when appropriate. Limit use of newly established recovery sites to uses related to establishment, monitoring, or related purposes.
Significant natural communities	
General	Avoid loss or fragmentation of significant natural communities from recreation facility siting.
	Avoid facility siting on significant natural communities.
	A minimum buffer zone of 500 feet is recommended between significant natural communities and high-use facilities, unless natural or artificial features are present that protect the resources from surrounding land uses.
	A minimum buffer zone of 200 feet is recommended between significant natural communities and new roads and trails, unless natural or artificial features are present that protect the resources from surrounding land uses.

Topic	Development Guidelines
	Minimize erosion during facility construction near significant natural communities. During facility construction in areas near significant natural communities, restore the plant communities (ground cover) to prevent soil erosion into significant natural communities.
	Fence significant natural communities within 500 feet of high-use recreation facilities.
	Confine trail users to established trails via enclosures and signs.
Alkali wetland complexes	All general guidelines apply for significant natural communities.
	Locate downslope those high-use intensive recreation facilities or other facilities that generate runoff to prevent site runoff from entering alkali wetland complexes. Buildings and facilities should be sited downslope from alkali wetland complexes, or runoff can be prevented from entering the alkali wetland complexes by installing drainage systems or by grading sites to eliminate offsite runoff. Modification of normal runoff conditions should be avoided.
	Avoid siting trails, roads, or facilities that could divert natural watershed surface water from alkali wetland complexes, and avoid separating alkali wetland complexes from an upslope watershed (e.g., site feature downslope, or design features to allow free passage of watershed runoff).
	Avoid recreational activities that could cause soil erosion in wetland complexes.
Northern claypan vernal pool	All general guidelines for significant natural communities apply. Guidelines identified for alkali wetland complexes also apply to vernal pools.
Valley rock outcrop intermittent pool	All general guidelines for significant natural communities apply.
	Avoid recreation activities that could result in disturbance of the water or vegetation within the intermittent pool during the wet season.
	Avoid recreation activities that could alter the natural hydrology of the intermittent pool (e.g., placing features above the pool basin or removing any sandstone around the pool).
	Restrict public access to guided tours or other monitored, nonintensive recreation during the wet season. Fence the resource to discourage excessive human use.
Palmer's oak chaparral	Because of the insensitivity of this community to disturbance and the rough terrain that it occupies, no additional guidelines are recommended outside those outlined in the general guidelines.

Topic	Development Guidelines
Valley needlegrass grassland	All general guidelines for significant natural communities apply.
Oak and willow-cottonwood riparian woodlands	All general guidelines for significant natural communities apply. Prohibit the loss of riparian woodlands, especially along drainages. If recreation use in these areas is unavoidable, trails should cross riparian woodlands perpendicular to their drainage in a manner that minimizes damage or loss of the trees. Prevent the loss of native oaks associated with recreation development. Restrict recreation activities that induce soil erosion along designated trails and use areas. Monitor recreation activities near drainages, and recommend remedial actions if erosion occurs. Locate high-use, intensive facilities and use areas that generate runoff in a manner that would prevent alteration of normal runoff conditions. Avoid drainages associated with riparian woodlands, as described under the drainage guidelines.
Other natural resources	
Drainages	All general guidelines for significant natural communities apply. Avoid drainages wherever possible. If avoidance is impossible, design facilities to avoid jurisdictional wetlands, which have greater ecological values. Where impacts are unavoidable, provide full compensation for habitat acreage and value, in accordance with the Section 404 permit process. Design project features such as roads and trails to cross perpendicular to drainages in a manner that minimizes damage to the drainage. Design recreational facilities upslope of drainages so that they do not impede the normal surface water flow in drainages. Site trails, roads, or other features in a manner that does not separate the drainage from an upslope watershed (e.g., locate feature downslope, use culverts, or design the feature to allow the free passage of water to the drainage). Restrict recreation activities in areas near drainages that induce soil erosion or that remove vegetation cover and increase soil disturbances. Hiking, bicycling, or horseback riding should be restricted to designated trails. Locate facilities that require irrigation so that facility runoff does not enter drainages.

Topic	Development Guidelines
Native oaks	Prevent the loss of native oaks whenever possible, especially healthy, mature oaks with a trunk diameter at breast height (dbh) of 18 inches. Dbh is a standard method for measuring the diameter of trees at approximately 4 feet 6 feet above the ground.
	Avoid soil disturbance, trenching, cut or fill, paving, or other activities within tree driplines. Landscape areas near native oaks with plant species that do not require irrigation.
	Avoid irrigation within tree driplines.
Wildlife resources	
San Joaquin kit fox	Conduct preconstruction surveys of potential and occupied kit fox habitat and undertake appropriate precautions during facility construction as outlined in the Vasco Road and Utility Relocation Project EIR.
	Avoid siting recreation facilities within a 0.5-mile radius of the natal den in the Herdlyn watershed.
	Avoid siting trails within a 0.5-mile radius of the natal den; the buffer distance may vary but should be large enough to avoid direct line-of-sight visibility from the den.
	Prohibit pets and firearms in areas with known kit fox occurrences.
	Limit speeds on roads in potential kit fox habitat to 25 miles per hour.
Alameda whipsnake	Avoid construction and facility siting in optimal whipsnake habitat.
	Limit hiking, biking, and equestrian uses to trails in whipsnake habitat.
	Control public automobile traffic on existing watershed roads within whipsnake habitat.
Golden eagle	Establish appropriate spatial buffers between high-use recreation facility siting and active golden eagle nest sites. For recreation planning purposes, a distance of 0.5 mile is recommended. Actual buffer distances would depend on the topography, line-of-sight distance to nests, and type of disturbance and may be greater or less than 0.5 mile in some cases.

Topic	Development Guidelines
	Temporal buffers (restriction of activity within an area or period of time) may supplement, or in certain cases replace, spatial buffers. Temporal buffers should extend at least from the time of arrival of the adult birds in the nesting area through the first few weeks of nestling development (February through May). Major recreation uses near nests (within 0.5 mile) should be avoided or postponed, if feasible, until fledging of young is completed and the young are independent of the nest area.
	Maintain a buffer distance of at least 1 mile between an active nest site and any blasting activities associated with recreation development. This buffer distance could depend on the topography or line of site distance to an active nest site.
	Avoid locating new roads and hiking, biking, and equestrian trails near known active golden eagle nests.
Burrowing owl	Conduct preconstruction surveys for active burrowing owl nests during the breeding season (March through September) when the young are still dependent on the adults and in the burrows.
	Establish a 200-foot-wide buffer zone around any active burrows during facility construction. The buffer zone should be fenced to prevent inadvertent mortalities.
	Avoid siting new roads and trails within 200 feet of an active burrowing owl den.
Curve-footed hygrotus diving beetle	Maintain a 100-foot buffer around all water bodies.
	Restrict building siting and construction activities near existing water bodies.
	Restrict construction of stream crossings to summer low-flow periods (June-September) to minimize soil erosion impacts on water bodies.
	Avoid use of water from water bodies with known curve-footed hygrotus diving beetle populations for construction-related activities.
	Confine mountain bikes, horses, and hikers to roads and trails in the vicinity of curve-footed hygrotus diving beetle populations by controlling trail access with gates and fencing, where appropriate.
California tiger salamander	Follow guidelines outlined for curve-footed hygrotus diving beetles to protect water bodies.
	Limit grading activities within 0.5 mile of known occupied salamander breeding sites to protect salamanders in burrows.

Topic	Development Guidelines
California red-legged frog	Follow guidelines described for curve-footed hygrotus diving beetles.
Western pond turtle	Follow guidelines described for curve-footed hygrotus diving beetles.
Fairy shrimp	Avoid recreation or other disturbing activities in the rock outcrop intermittent pools.
Cultural resources	
Vasco Caves	Prohibit open public recreation activities in or near caves.
	Establish a minimum buffer zone of 2,000 feet around the entire Vasco Caves area.
	Establish a line-of-sight buffer around Vasco Caves, in addition to the 2,000-foot buffer, so that rock outcrops containing cultural resources are not visible from any recreation use area. Screening the area by establishing trees could be used to obscure views of the outcrops.
	Physical barriers, such as permanent fencing, may be needed around the more sensitive caves.
	Discourage recreation use near the caves by strictly controlling public access on existing roads with gates or berms.
	An onsite caretaker or security patrol may be required near the caves to regularly patrol the area and prevent unauthorized entry.
	Site visits to the caves should include only individuals who have with documented professional or scientific interests or who serve as Native American monitors. Educational site visits for the public could be acceptable, but only if a policy for such visits is formulated in consultation with appropriate Native American groups.
Prehistoric resources	Prohibit siting recreation use areas or facilities on cultural sites. A minimum buffer zone should be established and maintained.
Historic resources	Prohibit siting recreation use areas or facilities on or near historic cultural sites. A minimum buffer zone of 500 feet should be maintained.

Section A-3. Detailed Construction Information for the Los Vaqueros Project Alternatives

LOS VAQUEROS RESERVOIR ALTERNATIVE CONSTRUCTION

Dam Construction

Foundation Preparation

The foundation preparation for the dam would involve excavating and removing approximately 560,000 cubic yards (cu yd) of overburdened soils and some weathered rock to reach a reasonably sound rock surface for the dam foundation. When exposed to air and water, removal of the last 12-24 inches of excavation could be delayed until just before placement of the foundation materials. This measure would minimize the exposure of these areas to air and water before embankment construction.

Foundation excavation activities would involve scrapers, bulldozers, front-end loaders and other construction equipment. Some blasting may be required.

Disposal of Spoil Material

Approximately 200,000-400,000 cu yds of waste material from dam, spillway, and inlet/outlet works excavations would be placed in an area on the upstream face of the west (left) dam abutment, within the reservoir inundation zone.

Grouting

To prevent leakage under the embankment when the reservoir is full and to consolidate the foundation beneath the proposed dam, bore holes, into which grout would be pumped, would be drilled in the foundation area of the dam. Fractures in the bedrock near the dam site have been thoroughly mapped.

Grouting materials typically consist of cement and water, with the possible inclusion of other materials, such as clay, sand, asphalt, and various chemicals, to modify the setting time and grout properties.

Dewatering

Because the water table may be relatively shallow at the damsite (10-15 feet), groundwater would be pumped out so that it would not pool in the excavation areas. Water pumped from the dam foundation area would be routed to a small sedimentation basin, from which point water would be pumped from near the water surface and released to Kellogg Creek immediately downstream of the dam site or used onsite.

Diversion of Kellogg Creek

To avoid inundation of the areas excavated during foundation preparation, flows from Kellogg Creek would be diverted through a temporary conduit designed to carry Kellogg Creek flows through the excavation area. Before the reservoir is filled, the conduit would be plugged with concrete to prevent leakage.

Embankment Construction

The various materials needed to construct the dam embankment would be obtained primarily from onsite sources, with some materials being imported from offsite sources. To minimize stockpiling, imported materials would probably be placed and compacted at approximately the same rate as delivery of the materials. The different materials would be placed and compacted in predetermined zones by scrapers, graders, compactors, bulldozers, and other equipment.

Spillway Construction

As presently conceived, spillway construction would involve excavating 160,000 cu yds of soil and rock from the top and north-facing slope of the west (left) dam abutment.

Excavation probably could be accomplished with bulldozers equipped with ripping equipment. In some areas, however, blasting might be required.

Inlet/Outlet Works Construction

The inlet/outlet tunnel shaft would be excavated using drill and blast methods and would be lined and grouted to improve hydraulic conditions and prevent leakage. Dewatering pumps may also be required during construction of these facilities.

Reservoir Clearing

Reservoir clearing would involve removing all existing asphalt road surfaces, trees, shrubs, and structures within the inundation zone. All usable timber would be salvaged, and

all other materials, including those from structures and nonsalvageable vegetation, would be trucked to local solid waste facilities. The total amount of waste materials is estimated to be 15,000-30,000 cu yds. A large volume of material, including shales and overburden soils, would also be excavated from the inundation area for use as embankment materials. Additional information regarding this excavation is provided below under "Materials and Transport".

To avoid contamination of the reservoir, the inundated portion of Vasco Road would be partially removed. The road surface would be excavated and hauled to local solid waste facilities and the remaining roadbed would be left intact.

Materials and Transport

Estimates of the amount of materials for the construction of the dam, inlet/outlet works, and spillway are:

- 107,000 cu yds of riprap,
- 16,000 cu yds of concrete,
- 430,000 cu yds of filter and drain materials,
- 2,450,000 cu yds of clay core and shell material, and
- 1,000 feet of steel tunnel liner and bifurcation piping.

Additionally, construction equipment would be transported from throughout Contra Costa County and neighboring counties.

The riprap needed would be trucked to the dam site from a commercial quarry located in Solano County just east of Vallejo and would be transported south on Interstate 780 (I-780) to I-680, east on SR 4, and south on Walnut Boulevard to Vasco Road. Twenty-ton-capacity trucks would be used at a frequency of about 26 trucks per day over an estimated 15-month period.

Alternatively, construction of the dam embankment could involve the use of riprap and other materials excavated from within the Kellogg Creek watershed. If this option were pursued, riprap would be excavated from the top of the ridge immediately above the dam site on the west (left) abutment, and shell materials would be excavated from both the ridge and an area within the inundation zone. If these areas were selected, approximately 60,000 cu yds of riprap and 900,000 cu yds of shell material would be removed from the ridge site for dam construction. Approximately 200,000 cu yds of shell material would be excavated from the inundation zone.

Use of materials excavated from the ridge adjacent to the proposed dam site could represent a substantial cost savings over the use of materials transported from offsite. In addition, the amount of truck traffic generated by transporting riprap from Solano County could be reduced by 60%.

The estimated 16,000 cu yds of concrete translates to approximately 2,000 trucks over a period of 15 months, with a typical placement of 200 cu yds per day and requiring about 25 ready-mix concrete trucks. This traffic would occur about 80 days out of the estimated 15 months of spillway and inlet/outlet works construction work. Concrete needed for proposed spillway and inlet/outlet works would most likely be transported to the site by ready-mix concrete trucks from Pleasanton via I-580 and Vasco Road.

Filter and drain materials needed for dam construction would be transported to the site using trucks with 20-ton capacities, translating to 106 trucks per day over the estimated 15 months of dam embankment construction. These materials would be transported from Pleasanton along I-580 and Vasco Road.

Impervious clay core and shell materials would be obtained from within the watershed. The approximately 2,450,000 cu yds of these materials would be excavated from areas within the reservoir inundation zone.

Steel pipe for the outlet tunnel liner and bifurcation piping would most likely be transported to the dam site from Tracy north on Corral Hollow Road, northwest on Byron Road, east on Camino Diablo Road, then south on Vasco Road. These materials would be trucked to the site in approximately 18-foot lengths, which would amount to the transport of approximately 65 truck loads over a span of about 4 months.

Generally, dam construction activities would require between 25 and 170 people at the site daily over the 23-month construction period. This estimate includes CCWD staff, engineers, and contractor field office staffs, as well as construction workers.

Supplemental Intake Facility Construction

Activities generally required for the construction of the supplemental intake and fish facilities include excavation, dewatering, facilities placement, levee modification, and spoil disposal.

Approximately 15,000 cu yds of waste material would be excavated from the intake and pumping plant site using standard construction practices. Because a number of intake locations are under consideration, spoil disposal areas would vary according to the various project configurations.

After excavation, a bed of gravel would be placed at the bottom of the excavated area to provide a suitable working surface. Approximately 200 piles would then be driven to support the facility. Following pile-driving activities, forms would be constructed and the concrete for the facilities would be placed. Once the concrete had set, most of the remaining construction work would involve the installation of permanent equipment, such as pumps, piping, valves, and electrical switchgear.

Construction of the new intake facilities would require the installation of sheet piles to allow dewatering of the construction site and construction of new levee sections behind the intake facilities. Once the intake facilities and a modified levee were constructed behind the sheet piles, the piles would be removed, along with the old levee.

An estimated 7,100 cu yds of concrete would be used for the intake and pumping plant facilities, translating to approximately 890 truckloads during a 24-month period. The concrete would most likely be transported to the site from Antioch via SR 4 through Brentwood.

Approximately 200 steel or concrete piles, which would be used to support the intake facilities and pumping plant, would be transported to the site from the Stockton area via SR 4. Approximately 40 trucks would be required over an 8-week period to transport the pilings.

Heavy equipment, such as scrapers, bulldozers, loaders, cranes, pile drivers, and compactors, as well as permanent equipment, such as pumps, gates, valves, piping, and electrical switchgear, would be transported to the site from throughout Contra Costa County and neighboring counties.

Construction of the intake facilities would require from 1 to 50 workers over the 24-month construction period.

Transfer Reservoir and Pumping Plant Construction

Construction of the transfer reservoir and transfer reservoir pumping plant would involve excavating a total of approximately 6,000 cu yds of material from the facility site. Approximately 4,350 cu yds of concrete would be needed for completion of the transfer reservoir and transfer reservoir pumping plant, equating to approximately 545 truckloads over the 2-year construction period. The concrete would most likely be imported from a ready-mix concrete plant in Antioch via SR 4, Walnut Boulevard, and Vasco Road.

During the construction period, a low volume of trucks would be required to regularly transport construction equipment and other permanent construction materials. These trucks would originate from throughout Contra Costa County and neighboring counties.

Construction of the transfer reservoir and pumping plant would require from 1 to 50 workers over the 24-month construction period.

Conveyance Facility Construction

CCWD estimates that construction of pipelines would generally proceed at a rate of 100-200 feet per day, but less at major road crossings. CCWD would construct the various pipelines concurrently.

In general, construction of the project conveyance facilities would involve pipe fabrication, trench excavation, bedding installation, pipeline placement, and backfill.

The various Old River and Clifton Court Forebay conveyance pipelines would be 90 inches in diameter, while the Los Vaqueros pipeline would be 96 inches in diameter. Piping would be fabricated offsite and trucked to construction areas at numerous intervals along the pipeline routes. The right-of-way would be approximately 125 feet wide, allowing for the width of the trench, stockpiles, and maneuvering space for heavy construction equipment. The actual width of the right-of-way would also depend on soil conditions in the area and the depth of the trench, because the trench wall would need to be sloped back as far as necessary to provide a stable wall condition, but would generally not be greater than 125 feet wide.

To place the pipelines, a bottom trench width providing 2 feet of clear space on either side of the pipe would be excavated. Safety regulations set by the U.S. Occupational Safety and Health Administration generally allow a 5-foot vertical wall at the bottom of the trench. Above 5 feet, the trench wall would be sloped back to prevent slope failure. In some cases, shoring of the trench wall could allow steeper trench walls. For the most part, the pipeline would be buried 5 feet deep, but the depth could be increased to 10 feet or more where existing or future roadways or underground utilities are crossed.

Where pipelines cross major roadways, such as SR 4, the pipeline would be "jacked" under the roadway, allowing roadway service to be maintained during construction. Construction of the pipeline under lesser roadways would involve excavation of the roadway. In these cases, only one lane would be closed at any one time, using standard construction practices (e.g., flaggers or warning devices) to ensure safe traffic flow.

Where alignments require pipeline crossings beneath railroad tracks, the railbed would be braced and all construction activities (excavation, tunneling, jacking, and back-filling) would be conducted without disruption of service.

Materials and Transport

Approximately 64,500 feet of 96-inch pipe would be required for construction of the Los Vaqueros pipeline. The pipe would be transported from Tracy along several different routes. Pipe for the northern section would be delivered via SR 4 to Brentwood, south on Walnut Boulevard and Vasco Road, then west on Camino Diablo Road. Pipe for the central section would be delivered via Byron Highway to Byron, then west on Marsh Creek

or Payne Road. Pipe for the southern section would be delivered via Byron Highway, then west on Camino Diablo Road.

Construction of the Los Vaqueros pipeline would require the importation and placement of approximately 204,400 cu yds of bedding material, which would translate to approximately 54 truckloads per day for the 24-month construction period. These materials would be transported to the site from Livermore, using Vasco Road and the same routes as described above. Access to the pipeline right-of-way would also be provided at the points described above.

Disposal of Spoil Materials

Placement of the 90- to 96-inch-diameter pipelines would displace some excavated materials. These materials would be placed on top of the pipeline after the trench had been backfilled with suitable materials. The displaced materials would be spread across the construction right-of-way, resulting in a slight rise of 2-3 feet along the pipeline right-of-way. Topsoil removed from the area to be excavated would be stockpiled and used to cover displaced excavated materials. The entire right-of-way would then be reseeded with an appropriate seed mixture in areas that are not croplands or orchards. Spoil materials would not be placed in sensitive habitat areas, such as wetlands, where such placement might alter local hydrologic conditions, or in floodplains identified by the Federal Emergency Management Agency (FEMA) because of possible alteration in floodflows.

Staffing

Los Vaqueros and intake pipeline construction would require up to 35 people per day onsite.

Electric Transmission Line Construction

To construct a 69-kV transmission line, small holes would be excavated to allow placement of the wooden poles. Although no pile drivers would be required for most of the construction, poles might need to be driven in areas adjacent to the Delta channels. Assuming a 10-person crew, construction of the transmission line would take place at a rate of approximately 1 mile per month.

Connecting to 230-kV facilities would involve constructing steel lattice towers. The towers would be constructed on the ground and then raised to an upright position. The towers would be contained within a 30-foot square area with concrete footings approximately 2-3 feet in diameter. Construction would take place at a rate of approximately 1 mile per month, also assuming a 10-person crew.

Alternate Project Configuration Construction

The following sections describe construction methods and issues for alternate project configurations that vary from the general discussion above.

Construction of Rock Slough/Old River No. 3 Configuration

Construction of the Old River No. 3 pipeline would involve placing the pipeline in an excavated trench under water in the Werner-Dredger Cut, located approximately 2.5 miles west of Old River. Normal flow and water-borne traffic would not be disrupted during construction activities. Similarly, the pipeline would be jacked beneath the ECCID main canal, and canal service would not be disrupted.

Construction of Rock Slough/Old River No. 4 Configuration

Construction of the Old River No. 4 pipeline would involve placing the pipeline in an excavated trench under water in the Werner-Dredger Cut, located approximately 2.5 miles west of Old River. Normal flow and water-borne traffic would not be disrupted during construction activities. Similarly, the pipeline would be jacked beneath the ECCID main canal, and canal service would not be disrupted.

Construction of Rock Slough/Clifton Court Forebay Configuration

The Clifton Court Forebay intake facilities would require the construction of a longer intake channel than the other Los Vaqueros Reservoir Alternative configurations, requiring the disposal of approximately 165,000 cu yds of spoil material, which would be dried and permanently disposed of near the intake facilities.

KELLOGG RESERVOIR ALTERNATIVE CONSTRUCTION

Dam Construction

Construction of Kellogg Reservoir would involve constructing Kellogg dam, nine associated saddle dams, inlet/outlet facilities, and spillway facilities.

Kellogg Dam and Saddle Dams

Although the Kellogg dam and saddle dams would differ with respect to size and material requirements; methods, materials and designs similar to those described above

under "Construction of Los Vaqueros Reservoir Alternative" would be used. The description of construction activities given below would apply to all the dams required for the Kellogg Reservoir Alternative. All figures given below for amount of embankment material are aggregated for all the dams.

Foundation Preparation

The foundation preparation for the Kellogg dam and saddle dams would involve excavating and removing approximately 1 million cu yds of overburden soils and some weathered rock to reach reasonably sound rock.

Foundation excavation would involve scrapers, bulldozers, and front-end loaders. The spoils would be disposed of near each dam site in the Kellogg Reservoir inundation zone.

Grouting

To minimize leakage under the dams when the reservoir is full, and to consolidate the dam foundations, grouting procedures would be undertaken as necessary at the Kellogg dam and all the saddle dam sites. Although additional geotechnical work would be required to determine the precise grouting procedures, these activities would be similar to those described above under "Construction of Los Vaqueros Reservoir Alternative".

Dewatering

Because of the high water table in the area of the Kellogg dam site, dewatering would be required. Under this alternative, the process for dewatering is identical to the process described above under "Construction of Los Vaqueros Reservoir Alternative".

Diversion of Kellogg Creek

As under the Los Vaqueros Reservoir Alternative, Kellogg Creek would need to be diverted to avoid possible inundation of the Kellogg dam site during embankment placement. Procedures for diverting Kellogg Creek are described above under "Construction of Los Vaqueros Reservoir Alternative".

Inlet/Outlet Shaft Construction

Inlet/outlet shaft construction would be completed using drill and blast methods, with dewatering pumps being used to keep the tunnels clear of water during construction.

Reservoir Clearing

Under the Kellogg Reservoir Alternative, the reservoir clearing activities would be carried out as described above under "Construction of Los Vaqueros Reservoir Alternative". All shrubs, trees, and structures would be removed, as would the Vasco Road roadway surface. All usable timber would be salvaged, and all other cleared materials would be trucked to local disposal sites. Approximately 16,800 cu yds of material would be removed from the site.

Disposal of Spoil Material

Other than those materials used in construction of the embankments, all excavated material would be disposed of within the reservoir inundation zone of the Kellogg Reservoir site.

Materials and Transport

All materials for the above facilities would be transported along the same routes as those identified under the Los Vaqueros Reservoir Alternative. However, because more material would be required, construction would take approximately 11 months longer.

Approximately 79,000 cu yds of filter and drain materials would be transported to the site from Pleasanton, with an estimated delivery rate of 72 trucks per day over a 26-month period.

Core and shell materials would be excavated from the valley floor within the Kellogg Reservoir site.

Steel pipe for the inlet/outlet tunnel and bifurcation piping would be transported to the site from Tracy. Approximately 1,100 feet of pipe would be transported, with 64 truckloads needed for delivery over a 4-month period.

Approximately 150,000 cu yds of riprap would be transported to the site from Solano County. Approximately 17 truckloads per day would be required over a 20-month period.

Concrete needed for spillway and inlet outlet facilities would be transported from Pleasanton, with 15,000 cu yds of concrete being delivered at a rate of 25 trucks per day for 75 days over a 14-month period.

Staffing

Embankment construction would take substantially longer than under the Los Vaqueros Reservoir Alternative because of the greater amounts of embankment materials needed. Generally, dam construction activities would require between 25 and 170 people at the site

over the 35-month construction period. This estimate includes CCWD staff, engineers, and contractor field office staff, as well as construction workers.

Construction of the Transfer Pipeline

The transfer pipeline would be constructed as described above under "Construction of Los Vaqueros Reservoir Alternative". However, because of the location of the Kellogg dam site, the transfer pipeline under the Kellogg Reservoir Alternative would be 0.5 mile long, requiring a corresponding amount of pipe and approximately 8,500 cu yds of bedding and backfill material.

DESALINATION/EBMUD EMERGENCY SUPPLY ALTERNATIVE CONSTRUCTION

Brine Disposal Pipeline

Construction of the brine disposal pipeline would require approximately 85,000 feet of 36-inch pipe, which would be delivered to the pipeline alignment from Tracy via Byron Road or SR 4 through Brentwood, Oakley, Antioch, and Pittsburg.

The pipeline would be laid at an approximate rate of 100-300 feet per day, depending on terrain conditions. One or two truckloads per day would be delivered at a constant rate over the 15-month construction period, assuming that the contractor uses two pipeline installation crews.

Approximately 106,000 cu yds of bedding and backfill material would be required and would be delivered at constant rate of 32 trucks per day over the 15-month construction period. The bedding and backfill material would be delivered along the same routes as described above for pipe transport.

An estimated 139,000 cu yds of excavated material not suited for bedding or backfill would need to be spoiled. Criteria for spoils disposal siting would be similar to those used for siting pipeline spoils and described above under "Construction of Los Vaqueros Reservoir Alternative". It is also possible that excess material may be used to reinforce levees at nearby tracts in the west Delta.

Between 12 and 20 workers per day per crew would be required over the estimated 23-month construction period.

The alignment of the brine disposal pipeline follows existing rights-of-way for most of the pipeline length. Where construction occurs within roadways, standard construction practices (e.g., the use of flaggers or warning devices) would be used to ensure safe traffic flow.

EBMUD Intertie Pipeline and Valve Structure

Approximately 13,000 feet of 48-inch-diameter steel pipeline would be required for construction of the EBMUD intertie pipeline under this alternative. The pipeline would be delivered to the pipeline alignment from Tracy along Byron Highway or SR 4 through Brentwood to Lone Tree Way or Neroly Road.

The pipeline would be laid at an approximate rate of 100-200 feet per day and would be delivered at a constant rate of one truckload per day over the 4-month construction period.

Approximately 22,600 cu yds of bedding and backfill material would be imported from Clayton via SR 4 through Pittsburg and Antioch. Access to the pipeline alignment would be made from Neroly Road and Lone Tree Way.

The EBMUD pipeline valve structure would require 270 cu yds of concrete, which would be delivered intermittently, requiring 50 truck trips over the 3-month construction period.

Heavy construction equipment, as well as permanent equipment and materials such as flow meters, electrical control panels, and hatch covers, would be transported to the site via Lone Tree Way from throughout the region.

Excess material from valve structure and pipeline excavation that cannot be used for backfill would be hauled to appropriate spoil areas. Although no spoil areas have been identified, siting criteria similar to those described above under "Construction of Los Vaqueros Reservoir Alternative" would be used.

The staffing for pipeline and valve structure construction would range from 12 to 20 people per day over the 8-month construction period.

Electric Transmission Line Construction

Construction of the new 230-kV transmission line under this alternative would be identical to the construction methods described above for the Los Vaqueros Reservoir Alternative.

MIDDLE RIVER INTAKE/EBMUD EMERGENCY SUPPLY ALTERNATIVE CONSTRUCTION

Middle River Intake Facilities and Orwood Tract Pumping Plant

Construction activities for the Middle River Intake and Orwood Tract Pumping Plant would involve excavation of the facilities site, levee modification, dewatering, and facilities placement. These activities would be carried out in a similar fashion for both facilities sites.

Excavation

Approximately 15,000 cu yds of material would be excavated from the intake site and pumping plant site. Because the excavated material would be extremely wet, it would be placed in a temporary drying area adjacent to the intake site before final disposal.

Levee Modification

This alternative would involve modifying existing levees in the areas of the intake, using the methods described above under "Los Vaqueros Reservoir Alternative". The levees on Woodward Island would also be reinforced to a distance of 500 feet north and south of the pipeline.

Dewatering

Once the intake and pumping plant sites are excavated, extensive ongoing dewatering would be required to prevent the excavation sites from becoming inundated. Water from the excavation site would be pumped back over the levees into Old River and Middle River.

Facilities Placement

After the sites have been dewatered, a layer of gravel would be placed at the bottom of the excavation site to provide a working surface suitable to support heavy construction equipment. After the gravel is placed, approximately 300 piles would be driven to support the facilities. Concrete would then be placed in several stages, the first to create a bottom slab and the next to provide the wall and roof surfaces.

After this point, all permanent equipment, such as pumps, fish screens, and electrical switchgear, would be added to the facilities. Once the intake facilities were in place and the modified levees constructed, the old levee would be removed.

Materials and Transport

The 9,300 cu yds of concrete required for intake and pumping plant construction would be transported to the site from a ready-mix concrete plant in Antioch, via SR 4 through Brentwood. Approximately 1,200 truckloads would be needed to deliver a variable rate of cement over a 24-month period.

The 300 50-foot-long steel or concrete piles used to support the structures would be transported to the site at a constant rate of approximately one or two per day over a 3-month period. The piles would be transported from the Stockton area via SR 4.

Heavy construction equipment, as well as permanent equipment such as pumps, gates, pipe, and electrical switchgear, would be transported to the sites intermittently from throughout the region.

Access to the Middle River intake site would be from a boat or barge launched from a nearby marina or from the Woodward Island Ferry at the southeast corner of the Island. Access to the Orwood Tract pumping plant would be from the west on Orwood Road.

Staffing and Timing

Up to about 50 people per day would be required at the intake and pumping plant sites over the 24-month construction period.

Middle River Pipeline

The 12.5-mile-long Middle River pipeline would be constructed similar to that of the Old River pipelines described above under "Los Vaqueros Reservoir Alternative". Construction of this pipeline, however, would involve tunneling beneath Old River immediately to the east of the pumping plant on Orwood Tract.

Although the pipeline construction rate west of Old River would be comparable to the rate described above under "Los Vaqueros Reservoir Alternative" (100-200 feet per day), because of dewatering requirements and soil conditions, the pipe-laying rate east of Old River would be closer to 100 feet per day. The pipe would be transported to the site from Tracy at a constant rate of 8-10 truckloads per day over a 19-month period. In addition, approximately 361,000 cu yds of bedding and backfill material would be trucked to the sites along the same routes as indicated above at a constant rate of 90 trucks per day over a 19-month period.

An estimated 480,000 cu yds of excess material from pipeline construction would be disposed of within the pipeline right-of-way. Spoil material would not be placed in sensitive habitat areas, such as wetlands where such placement may alter local hydrologic conditions or in floodplains identified by FEMA because of possible alterations in floodflows.

Up to approximately 35 people per day would be present at the pipeline construction site over a 19-month period.

Section A-4. Alternatives Eliminated from Detailed Analysis

INTRODUCTION

As described in greater detail in CCWD's Draft Section 404(b)(1) Alternatives Analysis for Meeting Water Quality and Reliability Objectives, a three-stage screening process is being conducted as part of the alternatives analysis, in compliance with the Clean Water Act Section 404(b)(1) Guidelines. The first two stages of screening have been completed, in which over 120 possible alternatives were analyzed. This EIR/EIS represents the third screening stage. Those alternatives considered but eliminated in the first two stages of screening are described below.

CCWD has two related but distinct basic project purposes that must be met for an alternative to be practicable: water quality and water reliability. All of the alternatives analyzed potentially met, either individually or in combination with other potential alternatives, at least one of the basic project purposes. The alternatives analysis was structured so that potential alternatives were identified and then tested to determine their ability to meet each project purpose independently within the limits of cost, existing technology, and logistics.

The first-stage evaluation was conducted to eliminate those alternatives or combination of alternatives that could not meet either the basic water quality or basic water reliability project purpose. In the second-stage evaluation, alternatives or combinations of alternatives that potentially could have met the water quality project purpose were combined with those alternatives or combinations of alternatives that potentially could have met the water reliability project purpose. Evaluation of alternatives at this stage required more detailed analysis because clear and compelling reasons for rejection were not always obvious. The second-stage evaluation, with closer inspection, eliminated those alternatives or combinations of alternatives that could not reasonably meet either basic project purpose. Alternatives eliminated during the first two stages of evaluation are described below.

ALTERNATIVES CONSIDERED BUT ELIMINATED AFTER THE FIRST-STAGE EVALUATION

Delta Intake Relocation

Relocation of the intake from Rock Slough to another site in the Delta was a potential nonreservoir alternative that could have reduced CCWD's current water quality problems. A Delta intake relocation project would have abandoned the existing CCWD intake at Rock Slough. This alternative would have included constructing a new intake facility, including a fish screen and pumping plant, at another Delta location, and a pipeline or canal would have been included to convey water from the new intake location to the Contra Costa Canal at or upstream from the Randall-Bold Water Treatment Plant. Also, the Contra Costa Canal, between the tie-in with the intake pipeline and the Randall-Bold Water Treatment Plant, would have been expanded.

An alternative involving relocating CCWD's intake to Old River, Indian Slough, Clifton Court Forebay, the California Aqueduct Intake Channel, or Harvey O. Banks Pumping Plant discharge would not have satisfied CCWD's water quality objectives, based on DWR water quality projections. Also, intake relocation at any of these locations would have failed to meet CCWD's water reliability objectives. Relocation to any Delta source, without increasing storage, still would have left CCWD's water supply unusable during certain Delta emergencies, especially Delta levee failure.

Intake relocation to Clifton Court Forebay, the California Aqueduct Intake Channel, or Harvey O. Banks Pumping Plant discharge would have posed a potential technical problem because of DWR diversion restrictions (Corps Section 10 permit limitations), which could have limited CCWD diversions. DWR and Reclamation have proposed a series of actions in the Delta, including enlarging Clifton Court Forebay; this proposal calls for all construction associated with these actions to be completed by mid-1996. Construction of a CCWD intake facility probably would have been necessarily delayed until enlargement of the existing forebay was completed, which would have made constructing this alternative intake facility within CCWD's time constraints impossible.

CCWD possibly could have relocated its intake to one of the four Delta islands proposed to be flooded for the Delta Wetlands Project. The Delta Wetlands Project would store water for later sale for beneficial uses, to provide waterfowl and other wildlife habitat for hunting and recreational opportunities, and for productive use of the four privately owned islands. Reliability objectives would not have been met because the Delta Wetlands Project, while storing up to more than 300,000 af of water, would release this water on an annual basis during May, June, and July; the Delta Wetlands Project would not maintain adequate storage in summer and fall to meet CCWD's reliability objectives. Also, the project is dependent on surplus Delta flows and would not operate at any time during years when surplus flows are unavailable and would operate at less than full capacity when surplus flows are available but limited.

Additional problems with CCWD's water quality improvement objectives and with timing and jurisdictional constraints were associated with using the Delta Wetlands Project as CCWD's water source. CCWD would have become completely dependent on the approval (permit) process for the Delta Wetlands Project. If permits are denied, the project proponent will implement intensive agriculture on the islands. In this case, CCWD would have been put at great risk and would have been unable to meet its basic project purposes in the near future. Furthermore, the Delta Wetlands Project proponent and CCWD have different objectives, and both parties have stated that a CCWD-Delta Wetlands joint project is unacceptable and will not be pursued.

Supplemental Delta Intake (with Rock Slough)

Maintaining the current Delta intake site at Rock Slough did not meet CCWD's water quality and reliability objectives. However, potential alternatives involving augmenting the Rock Slough site with another supplemental Delta intake site, either as a single project or combined with other alternatives, may have been a practicable alternative for meeting one or both project purposes.

A supplemental Delta intake alternative would have retained the existing Rock Slough intake facility and would have included a new, 250-cfs capacity intake facility, including a fish screen and pumping plant at another Delta location, a pipeline to convey water from the new intake location to the Contra Costa Canal at or upstream from the Randall-Bold Water Treatment Plant, and a blending facility at or immediately downstream from the point where the supply from the supplemental intake ties in with the Rock Slough supply. Also, expansion of the Contra Costa Canal, between the tie-in with the intake pipeline and the Randall-Bold Water Treatment Plant, would have been necessary.

For essentially the same reasons as described above in the "Delta Intake Relocation" section, a supplemental intake at Old River, Clifton Court Forebay, the California Aqueduct Intake Channel, Harvey O. Banks Pumping Plant discharge, Indian Slough, or the Delta Wetlands Project would alone not have met CCWD's basic project purposes and would have had major timing and jurisdictional constraints. For these reasons, these alternatives were eliminated from further evaluations.

Groundwater Management - East Contra Costa County Basin and Sacramento-San Joaquin Delta Basin

The major components of these potential alternatives were groundwater production and recharge facilities. Production facilities included production wells, a well field collection system, and conveyance facilities (pipelines and pumping plants) to deliver groundwater to CCWD's Contra Costa Canal. The recharge facilities included recharge basins and conveyance facilities extending from the canal to the groundwater basin to deliver recharge water from the Delta when Delta water quality is good. Groundwater management

alternatives had to be capable of delivering 56,000 af/yr of emergency storage. To meet instantaneous needs of CCWD customers, this quantity of water had to be available at a rate of 400 cfs. Also, groundwater management was evaluated for its ability to meet CCWD's water quality objectives.

Groundwater supply from eastern Contra Costa County or the Delta basin would not have met CCWD's water quality or reliability objectives. Use of either alternative would have required siting wells in a large, developing area, which also presented technical and environmental constraints. A groundwater system in the Delta would have been subject to failure during several emergency scenarios, such as levee failure from structural instabilities, earthquakes, or flooding.

Los Vaqueros Reservoir with Single Delta Intake, Supplemental Middle River Intake, or Delta Wetlands Project Intake

The major components of this set of potential alternatives were a reservoir at the Los Vaqueros site in the Kellogg Creek watershed and an intake facility at a Delta location. During periods of good water quality, system demands would have been met by the intake. During these same periods, if Delta water supplies were available for reservoir storage, water may have been pumped from the intake into the reservoir. When the chloride level at the intake exceeded 65 mg/l, water from the reservoir would have been blended with water from the intake to reduce the chloride level of water delivered to CCWD users. In the event of an emergency, reservoir water could have been used directly to meet system demands.

The water quality improvement and water reliability performance of a particular configuration was determined by the reservoir size and the water quality at the Delta intake location. Other project components, including pipelines, pumping plants, a blending facility, and a transfer reservoir, had an effect on total project costs but did not influence the water quality improvement or water reliability performance of a particular configuration.

The alternative of having the Los Vaqueros Reservoir with a Delta intake at either Rock Slough, Old River, Middle River, Middle River and Woodward Island Forebay, Clifton Court Forebay, Indian Slough, Rock Slough and Middle River, or the Delta Wetlands Project would have been cost prohibitive. A $350 million project configuration with an intake at any of these locations would have included a smaller storage reservoir at the Los Vaqueros site. A smaller, less expensive reservoir, coupled with the Delta intake, would not have met the 65 mg/l goal for chloride and therefore would not have met the CCWD water quality objectives. Other potential constraints with the various Delta intake locations were relevant for this alternative (see the "Delta Intake Relocation" section above). A Delta intake at California Aqueduct Intake Channel or Harvey O. Banks Pumping Plant discharge would not have been practicable because DWR has stated that long-term capacity in the Skinner fish facility is not available.

Other Storage Reservoir Sites

The major components of this set of potential alternatives consisted of an intake facility at one or two of the several Delta locations and a reservoir at one site or combination of sites other than the Los Vaqueros Reservoir or Kellogg Reservoir sites. Other project components, including pipelines, pumping plants, a blending facility, and a transfer reservoir, would have had an impact on total project costs but would not have influenced the water quality improvement or water reliability performance of a particular configuration. Operation of these project alternatives would have been similar to that of the Los Vaqueros Reservoir alternative.

Results of the initial screening of these reservoir alternatives are described below for water reliability, cost, technical, environmental, timing, and jurisdictional criteria. These alternatives were not generally screened for water quality criteria because water quality is heavily dependent on intake location. Such detailed configuration studies and water quality performance evaluations were conducted in second-stage screening for those alternatives that passed the first-stage screening. Reservoir sites that were evaluated and eliminated in first-stage evaluations are shown in Figure 1.

The Auburn, Upper Buckhorn, and Los Banos Grandes Reservoirs each would have cost well over $400 million. These reservoir alternatives would have been located a long distance from CCWD's service area, and the reliability of the conveyance system was questionable. The Auburn Reservoir alternative would have had potential significant impacts on American River fishery, wildlife, scenic, recreational, and other resources; it could not have been built within CCWD's schedule for project implementation, and major jurisdictional constraints existed. The Upper Buckhorn Reservoir did not meet the reliability criterion during normal years because its capacity would have been only 14,000 af. DWR has indicated that the wetland impacts at the Los Banos Grandes Reservoir site would have been great, and additional impacts on endangered species in the inundation area also would have occurred.

The Round Valley Reservoir site would have been difficult to obtain because it is currently owned and controlled by EBRPD and because San Joaquin kit fox have been located in the Round Valley Reservoir inundation area.

Storage capacity of the Upper Pinole and Pinole Reservoirs was insufficient to provide CCWD with both improved water reliability and quality. Based on an order-of-magnitude estimate, either reservoir alternative would have cost over $450 million, without meeting CCWD's basic project purposes. All inundated roads would have required relocation and reconfiguration. It would have been necessary to reroute electrical transmission lines that run along either site. EBMUD estimates that over 15 acres of wetlands would have been lost with a reservoir at either site. Three special-status plant species potentially occur at either reservoir site. Three special-status wildlife species potentially occur at either reservoir site. Pinole Creek historically had an anadromous rainbow trout (steelhead) run, and DFG has stocked rainbow trout in the past.

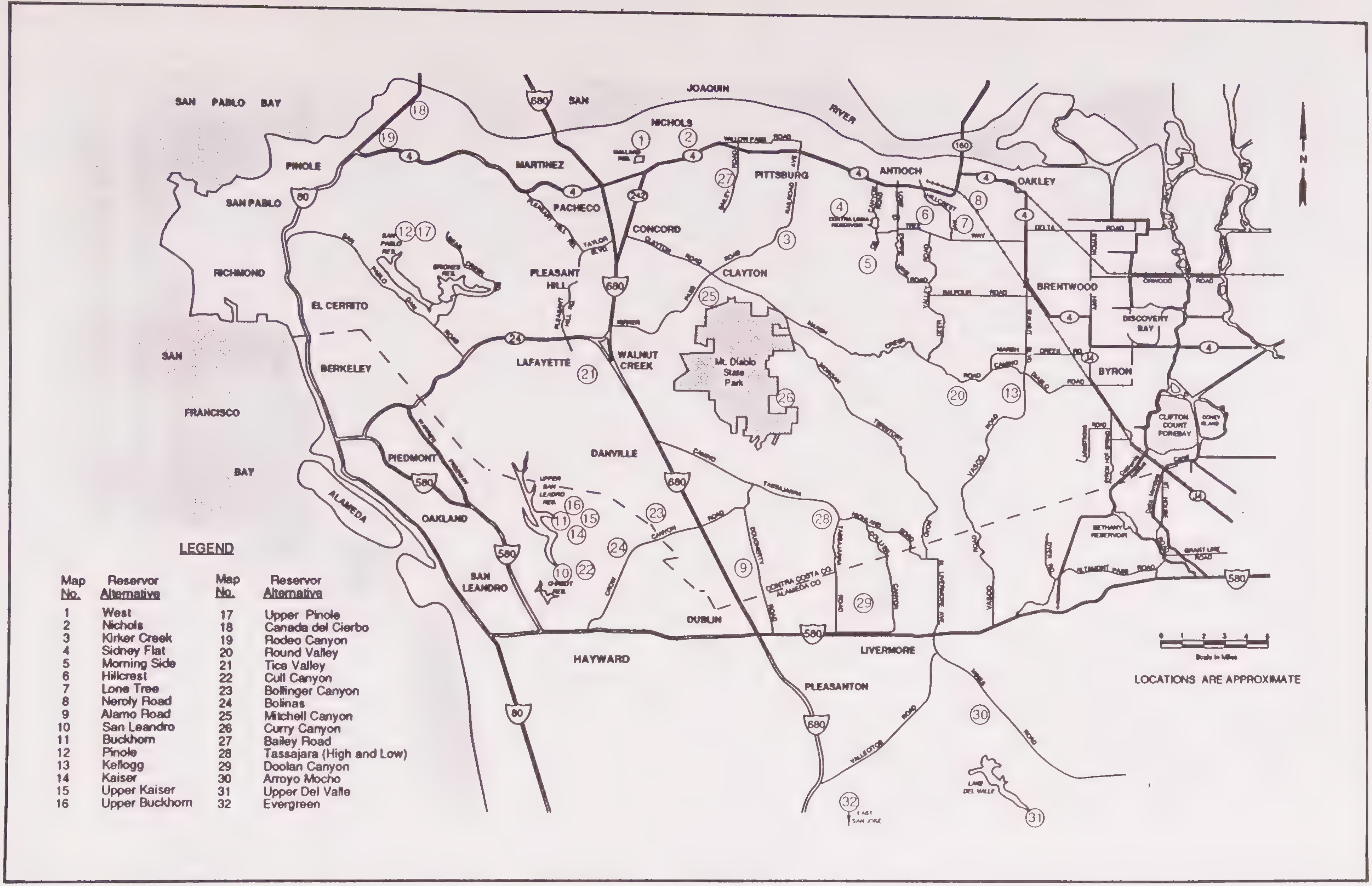

Figure 1. Reservoir Alternatives Analyzed in the 404(b)(1) Screening Process

Approximately 3 miles of the stream would have been inundated, including portions of the creek that may be perennial.

Storage capacity at the San Leandro Reservoir site was also insufficient to provide for both improved water reliability and quality to CCWD. Based on an order-of-magnitude estimate, the San Leandro Reservoir alternative would have cost over $400 million, without meeting CCWD's basic project purposes. Grazing land, a Christmas tree farm, roads, and electrical transmission lines would have needed to be relocated. Property acquisition from EBMUD and EBRPD would have been extremely difficult and costly. EBMUD estimates that 19 acres of wetlands would have been lost. Seven special-status plant species and the Alameda whipsnake potentially occur within the reservoir inundation area, and San Leandro Creek may support a remnant wild trout population. DFG also stocks rainbow trout in Lake Chabot, which is fed by San Leandro Creek, and some rainbow trout may spawn in San Leandro Creek. Approximately 6 miles of stream, which is considered high-quality, relatively undisturbed habitat, would have been inundated.

The Kirker Creek dam site was over 3,000 feet wide and, therefore, would have required a vast amount of embankment material for dam construction; dam construction alone was estimated to exceed $590 million. The Kirker Creek Reservoir capacity was 50,000 af, of which 40,000 af may have been used for emergency storage. The reservoir would have inundated maintenance facilities for EBRPD-owned Black Diamond Mines Park. Dam construction could not have been completed for the CCWD-projected 1995/1996 winter filling season.

The Upper Kaiser, West, Kaiser, Nichols, Curry Canyon, Mitchell Canyon, East, Bailey Road, Evergreen, Canada del Cierbo, Cull Canyon, Rodeo Canyon, Bollinger Canyon, Tassajara, and Alamo Creek Reservoirs would not have met CCWD storage capacity requirements; therefore, none of these alternatives met the CCWD reliability criterion during normal years. The Curry Canyon and Mitchell Canyon Reservoirs would have inundated a state game refuge. The East Reservoir would have inundated significant existing and proposed housing developments. Based on an order-of-magnitude estimate, the Evergreen Reservoir alternative would have cost well over $500 million. The Canada del Cierbo, Cull Canyon, Rodeo Canyon, Bollinger Canyon, Tassajara, and Alamo Creek Reservoirs would have displaced major housing, transportation, and public use facilities.

The Sidney Flat and Morning Side Reservoirs also would not have met CCWD capacity requirements for storage and, therefore, did not meet the reliability criterion during normal years. Either site may have had leakage problems because of nearby abandoned mine shafts; water quality problems also may have occurred as a result of drainage from mining operations nearby.

Based on an order-of-magnitude estimate, the Arroyo Mocho and Upper Del Valle Reservoirs each would have cost over $500 million. The Tice Valley Reservoir would have displaced major housing, transportation, and public use facilities.

Although the Bolinas Reservoir could have met CCWD capacity requirements, the reservoir would have needed to be connected to an intake at the Delta by means of a

40-mile-long pipeline and would have required a pipeline from the Delta intake to the Contra Costa Canal for direct diversion from the Delta and transfer of water from Bolinas Reservoir. Two pumping plants also would have been required to pump water from the Delta intake to Bolinas Reservoir and from Bolinas Reservoir to the Contra Costa Canal. Based on an order-of-magnitude estimate, the Bolinas Reservoir would have cost over $511 million. Also, dam construction could not have been completed for the CCWD-projected 1995/1996 winter filling season.

The Doolan Canyon Reservoir would have utilized a dam in Doolan Canyon north of I-580 in Livermore and would have been connected to an intake at the Delta by means of a 24-mile-long pipeline. This alternative would have required a pipeline extending from the Delta intake to the Contra Costa Canal for direct diversion from the Delta and transfer of water from Doolan Reservoir. One pumping plant would have been required to pump water from the Delta intake to Doolan Reservoir. Based on an order-of-magnitude estimate, the Bolinas Reservoir alternative would have cost over $430 million. Also, Doolan Canyon Reservoir would have displaced major housing, transportation, and public use facilities.

Delta Water Management Strategies

These potential alternatives involved managing water flows to and through the Delta to meet CCWD's Los Vaqueros Project objectives at the existing Rock Slough intake. By changing current Delta operation strategies, the chloride concentration at the Rock Slough intake might have been maintained within the CCWD objective of 65 mg/l. Two general ways in which the operation might have been changed would have been to alter the inflows to and outflows from the Delta and to make physical changes to the channels and flow patterns of the Delta.

To control Rock Slough chlorides and other aspects of Delta circulation, controlled water releases would have been made from upstream storage reservoirs of the CVP and SWP. By releasing more water into the Delta than was being exported, it would have been possible to lower the chloride concentration in Delta waters. These operations could have met CCWD's water quality objectives without the construction of new CCWD facilities. Also, enough water possibly could have been stored upstream to be released into the Delta if a Delta emergency occurred that rendered Rock Slough water quality unusable.

Although both of these changes to CVP and SWP operations are theoretically possible, they were considered institutionally and economically highly unlikely. The state and federal water projects are currently operated according to a complex set of rules to minimize water releases from upstream reservoirs, while concurrently meeting all Delta export, flow, and water quality requirements. Reducing chloride concentrations at Rock Slough would have required greater water releases from available storage than current releases. These increased releases would have decreased the firm yield of the CVP and SWP, which would have further reduced the supply available to other water users and beneficial uses. Increasing the amount of water typically held as upstream storage to protect

against a Delta emergency also would have reduced the supply available to other users and beneficial uses, and would have further lowered both CVP and SWP yields.

Costs associated with reimbursing the CVP and SWD for these large amounts of decreased yield would have been substantially larger than CCWD's cost criterion. Additionally, the magnitude of the institutional issues would have made it impossible to implement any of these Delta water management strategies by 1995-1997. Although this alternative would not have met CCWD's water quality and reliability criteria, CCWD is continuing to play a major role in the ongoing Bay-Delta proceedings and is continually seeking improvements in current Delta water management strategies.

Bottled Water/Home Treatment Devices

This potential alternative involved meeting CCWD's water quality objectives by providing bottled water and/or water treatment systems at individual residences. If bottled water were used, CCWD could have either supplied the water all of the time or only when the Delta source chloride concentration exceeded 65 mg/l. CCWD probably would have been required to assume responsibility for monitoring bottled water quality and maintaining home treatment devices to ensure compliance with drinking water and public health standards.

This alternative would have only provided water quality improvement benefits to domestic users, and only to their drinking water supply. Industrial water users and nontreated-water customers would have continued to receive water of existing quality, and benefits of reduced corrosion of water heaters and household appliances would not have been realized.

Potential jurisdictional constraints might have developed if the quality of pipe-delivered water had failed to meet all state and federal drinking water standards. In addition, existing standards for bottled water and home treatment may have been considered inadequate by DHS. This alternative would not have satisfied CCWD's reliability objective because not all of the CCWD service area would have had the benefit of bottled water; the home treatment devices might have been incapable of removing all potential contaminants, and jurisdictional constraints are inherent in mass distribution of bottled water or maintenance of home treatment devices.

Rock Slough Intake Channel Improvements

This potential alternative would have consisted of structural improvements to the existing canal and foundation or construction of a pipeline designed for seismic loading to replace the intake channel. Improvements would have helped increase reliability by reducing the probability that a channel failure from an earthquake or liquefaction would occur; however, because the major threat in the Delta is levee failure, in addition to

chemical spills, CCWD's water supply would still have been at risk. This alternative would not have provided any water quality improvement.

Rock Slough intake channel improvements could have been used as one component of a combination of alternatives to meet CCWD's basic project purpose, but the limited usefulness of this alternative in meeting a wide range of emergency scenarios that currently threaten CCWD's water reliability precluded this alternative from further consideration.

Delta Levee Improvements

Structural improvements to Delta levees could have reduced the risk of Delta levee failure and the corresponding high salinity, which would have effectively reduced the requirements for reliability storage or other means of decreasing salinity during such a levee failure, and satisfied one major objective for the water reliability criteria. Even if successfully implemented, however, Delta levee improvements would not have protected against the range of possible emergencies to the degree that storage projects can. This alternative would not have satisfied water quality criteria.

Previous studies by the Corps and DWR (California Department of Water Resources 1982) estimated the cost of levee improvements to preserve the Delta at $3.4 billion, far exceeding CCWD's cost criterion. CCWD could have participated in some joint effort to improve Delta levees, but this concept was not considered feasible because of jurisdictional constraints. Delta levee improvements could have been used as one component of a combination of alternatives to meet CCWD's basic project purpose; however, the extreme difficulty in implementing this alternative successfully by 1995 in a cost-effective manner precluded this alternative from further consideration.

Standby Power

The potential alternative of installing standby power units at all Contra Costa Canal pumping plants would have improved, but only partially satisfied, CCWD's reliability needs by eliminating loss of service during power outages. Standby power would not have improved water quality. The cost of installing standby power units was unknown but would have been added to the costs of other alternatives necessary to fully meet CCWD's basic project purposes. Standby power could have been used as one component of a combination of alternatives to meet CCWD's basic project purpose; however, this alternative's limited usefulness in solving a wide range of emergency scenarios that currently threaten CCWD's water reliability precluded the alternative from further consideration.

Regional Water Management

Potential alternatives involving regional water management consisted of pooling and jointly managing all or part of the water resources for a given area. For the purpose of this analysis, the study area was limited to water purveyors in the Bay Area that are adjacent to the CCWD service area or conveyance facilities that cross through or near the CCWD service area.

Connection to EBMUD Water Supplies

The EBMUD service area is adjacent to the western boundary of CCWD's service area. EBMUD's Mokelumne Aqueducts pass directly through CCWD's service area. CCWD and EBMUD possibly could have connected their raw water supply systems to allow joint use of CCWD's Delta supply and EBMUD's Mokelumne River and American River water supplies. Another alternative was to link the treated water systems of CCWD and EBMUD.

One possible EBMUD source would have been on the American River raw water supply, consisting of a direct connection of the Contra Costa Canal with the Mokelumne Aqueducts, or a joint pipeline from EBMUD's American River diversion on the Folsom South Canal to the CCWD and EBMUD service areas. The political sensitivity of using American River water and the legal constraints, estimated high cost, unreliability of the supply, potential environmental impacts, and other factors precluded CCWD's use of an American River supply.

Another possible EBMUD source would have been its treated water supply, consisting of a direct connection between the CCWD and EBMUD treated water distribution systems. Because the available supply of treated EBMUD water is limited and the capacity of treatment and distribution facilities is also limited, this alternative was infeasible.

Raw Water Interties or Exchanges with Other Local Agencies

CCWD could have constructed interties with other local water agencies or purchased water from or exchanged water with these agencies. One possible supply source would have been an intertie with San Francisco's Hetch Hetchy Reservoir (Tuolumne River) system with pipelines and pumping plants as required to transport Tuolumne River water to the CCWD service area. The availability of Hetch Hetchy Reservoir water is extremely limited and San Francisco did not indicate that its limited Tuolumne River supply would be available to the CCWD service area. Storage still would have been required to meet reliability criteria and water quality goals during periods when water was unavailable. The cost of this alternative would have been well over the $350 million cost criterion. Furthermore, this alternative could have affected other uses of Tuolumne River water (including power generation) and possibly fisheries in the Tuolumne River and Delta.

Another possible supply source would have been an intertie with the Alameda County Flood Control and Water Conservation District, Zone 7 system, most of which is Delta water from the South Bay Aqueduct (SBA), or an intertie with the Alameda County Water District (ACWD) system. Either connection would not have met CCWD's water quality or reliability criteria. In the exchange concept, Zone 7 or the ACWD would have pumped groundwater instead of diverting from the Delta through the SBA during certain periods, and CCWD would have diverted Zone 7's or ACWD's allotted Delta water; however, this system would not have helped CCWD meet its water quality goals because Zone 7 or ACWD water would have been of similar quality to CCWD's current supply. Jurisdictional constraints, such as restrictions on use of SBA facilities to convey nonproject water, could have limited the viability of such an exchange.

CCWD could have constructed interties with the Solano Water Authority (SWA). This alternative would have consisted of a connection to SWA member facilities. Because SWA's supply is limited, this connection would not have met CCWD's water quality or reliability criteria. The exchange concept would have been similar to that of connecting to Zone 7's system. This system would not have helped CCWD meet its water quality or reliability goals because SWA water would have been of similar quality. Jurisdictional constraints, such as restrictions on using North Bay Aqueduct facilities to convey nonproject water, could have limited the viability of such an exchange.

Another possible supply source would have involved an exchange with Marin Municipal Water District (MMWD) or an intertie with the SWA. Because MMWD's supply and storage capacity is limited, this alternative would not have met CCWD's water quality or reliability criteria.

Another alternative would have involved an intertie with the Santa Clara Valley Water District (SCVWD) system. Because SCVWD's supply is limited, this connection would not have met CCWD's water quality or reliability criteria. In the exchange concept, SCVWD would have used water from one of its alternative supplies instead of diverting from the Delta through the SBA or San Felipe Project during certain periods. CCWD would have diverted SCVWD's allotted Delta water and would have been required to replace groundwater pumped from SCVWD's basin by conveying Delta water (when available) through the SBA or San Felipe Project for groundwater recharge.

CCWD could have purchased water from Yuba County Water Agency (YCWA) and constructed pipelines to the YCWA system to deliver high quality water to CCWD's service area. Because YCWA facilities are remote from CCWD, storage would have been required for operational purposes (i.e., flow regulation) and to meet CCWD's reliability criteria. The cost of such an alternative would have greatly exceeded the $350 million cost criterion. As another alternative, CCWD could have purchased water from YCWA that is conveyed through and diverted from the Delta. This alternative, however, would not have met CCWD's water quality or reliability criteria.

CCWD could have constructed facilities to supply Woodbridge districts with Delta water in exchange for up to 39,000 af/yr of water from the Mokelumne River. This alternative had severe jurisdictional constraints; a similar proposal by EBMUD during the

1989 drought was not approved by SWRCB. Environmental impacts could have included impacts on Woodbridge district water users, groundwater basins, and fishery resources in the Mokelumne River.

Water Marketing and Exchanges with CVP or SWP Contractors

CCWD could have negotiated exchanges or water purchases from current CVP or SWP contractors. Under this concept, CCWD would have diverted water from its Delta intake that was purchased from or exchanged with CVP or SWP contractors. These alternatives would not have met CCWD's water quality or reliability criteria because severe jurisdictional constraints were expected.

Los Vaqueros Reservoir Joint Projects

These alternatives consisted of a joint Los Vaqueros Reservoir project with CCWD and one or more participating agencies. A joint project would have consisted of an enlarged dam and reservoir and appurtenant facilities that would have been designed to meet CCWD's water quality and reliability needs, as well as the participant's needs. CCWD's share of the costs were expected to be under $350 million.

CCWD has actively sought other water agencies to participate in the Los Vaqueros Project; the major constraint is that including any participants in the project at this time would have precluded CCWD from meeting its time constraints. CCWD could not have met its basic project purposes, taking into consideration cost, logistics, and existing technology, if any participants joined the project at this time.

Joint Participation in Currently Planned Projects

CCWD possibly could have participated in other projects currently planned by other water agencies; these projects include the Los Banos Grandes Reservoir, the Auburn Reservoir, and the Buckhorn Reservoir. As discussed above in the "Other Storage Reservoir Sites" section, these alternatives were not practicable for CCWD to meet its basic project purposes.

Sierra Nevada Supply Sources

Potential Sierra Nevada supply source alternatives involved moving the delivery point for part or all of CCWD's existing water supply contract with Reclamation from Rock Slough to a point above the Delta. (These alternatives did not include regional water management alternatives with existing Sierra Nevada supply sources discussed above.) Sierra Nevada supply source alternatives would have been similar to EBMUD's and San Francisco's Sierra Nevada supply sources. One set of alternatives involved moving the

diversion point for the entire 195,000 af/yr CCWD supply to a Sierra Nevada source point. The Rock Slough intake would have been maintained as an emergency diversion facility only. Another set of alternatives involved maintaining the Rock Slough intake for current 120,000 af/yr demands and diverting the remaining 60,000 af/yr from a Sierra Nevada source point. Because of the excellent quality of Sierra Nevada water, a Sierra Nevada source system could have been designed to meet CCWD's water quality criteria; none of the other screening criteria, however, could have been reasonably met with a Sierra Nevada supply as an individual alternative.

The Stage 1 EIR for the Los Vaqueros/Kellogg Project evaluated three major sources of supply for the purposes of storing high-quality water and allowing delivery to customers when source quality dropped or when the supply became unavailable. The considered sources of supply included Mokelumne River water, delivered by EBMUD's Mokelumne Aqueduct from Pardee Reservoir; American River water, delivered via a future aqueduct that would have connected the Folsom South Canal in Sacramento County with CCWD's service area, EBMUD's service area, or EBMUD's existing Mokelumne Aqueduct; and the existing Delta supply, delivered from Rock Slough, augmented by a new diversion point that might have offered enhanced water quality.

The Stage 1 EIR concluded that Mokelumne River water may not be available in dry years and years of recovery after dry years and that reductions in riverflows may affect downstream beneficial uses, which had been able to benefit from surplus flows in the river not currently used by EBMUD. Impacts of obtaining American River water would be determined by any differences in operating methods employed by Reclamation at Folsom Dam with and without the purchase. The Stage 1 EIR concluded that the impacts of relying on the Delta supply for CCWD's water needs would depend on the location of the altered diversions and the timing of those diversions (see analysis of alternatives in the "Delta Intake Relocation" section above).

Potential Sierra Nevada supply source alternatives analyzed for inclusion in this Stage 2 EIR/EIS would have required the construction of diversion facilities and a new conveyance system to bring the water from the Sierra Nevada source point to the Contra Costa Canal at or upstream from the Randall-Bold Water Treatment Plant. A Sierra Nevada supply source for all or a portion of CCWD's water supply needs potentially could have been developed at the following locations:

- Upper American River basin,
- Upper Feather River basin,
- Putah Creek basin,
- Sacramento River basin,
- Stanislaus River basin,
- Cosumnes River basin,
- Mokelumne River basin,
- Calaveras River basin,
- Tuolumne River basin, and
- Southern San Joaquin River basin.

Anticipated restrictions on the rate and timing of diversions from Sierra Nevada streams and the distance from the Sierra Nevada diversion point to the CCWD service area would have limited the ability of a Sierra Nevada system to meet the reliability criteria. CCWD would have required a dependable Sierra Nevada supply source during below-normal, dry, and critically dry years. Such a source could not have been realistically obtained to meet CCWD's basic project purposes, especially given CCWD's timing constraints.

Water rights would have been difficult to obtain by 1995-1997 because of the limited availability of unappropriated water in Sierra Nevada streams, and any water rights likely would have contained severe restrictions on the rate and timing of diversions. Adverse impacts on current Sierra Nevada water users would have been likely, especially during critically dry water years. Attempts by current water rights holders to obtain additional Sierra Nevada supplies have met with strong opposition from both environmental groups and regulatory agencies. Legal challenges would have been likely, further extending the date of obtaining such a source; litigation involving EBMUD's contract for American River water lasted 18 years.

Major, unavoidable environmental impacts of a Sierra Nevada supply source would have likely adversely affected fisheries resources in Sierra Nevada source streams. Without a storage component, direct diversion from a Sierra Nevada water source would have been necessary in below-normal, dry, and critically dry years. CCWD diversions, in addition to existing diversions from Sierra Nevada streams in these years, would have been detrimental and likely would have been prohibited by regulatory agencies.

CCWD possibly could have transferred the point of diversion of its existing water supply contract with Reclamation to a point upstream of the Delta. Such a transfer may have resulted in different project constraints, from a water rights perspective, but the major institutional and environmental problems identified in the preceding paragraphs still would have applied.

For these reasons, all Sierra Nevada source water supplies were considered impracticable for meeting CCWD's basic project purposes. Even when combined with other alternatives, such as a reservoir storage project to meet reliability criteria, Sierra Nevada source water supply alternatives involved the other major constraints identified in this section. Even if the opportunity of including Sierra Nevada water supplies at a future date existed, the cost of combining storage facilities with a Sierra Nevada diversion and conveyance system would have been well above $400 million.

ALTERNATIVES CONSIDERED BUT ELIMINATED AFTER THE SECOND-STAGE EVALUATION

Groundwater Management

Potential groundwater sources in the Livermore Valley and San Joaquin County basins were further evaluated in the second-stage screening. To be consistent with CCWD's screening criteria, an acceptable groundwater alternative had to be capable of supplying at least 56,000 af/yr of emergency storage. To meet the instantaneous needs of CCWD customers, this quantity of water had to be available at a rate of 400 cfs. The quality of the groundwater also had to meet CCWD's needs.

As discussed below, no groundwater alternatives met CCWD's established basic project purposes and criteria. The high costs, technical uncertainties, and jurisdictional constraints also precluded groundwater management alternatives from being combined with other alternatives to fully satisfy CCWD's basic project purposes. Groundwater management could not meet the water quality criteria, and the cost of adding additional facilities to improve water quality while developing groundwater as an emergency supply was prohibitive and subject to major jurisdictional constraints.

Livermore Valley Basin

The groundwater basin of the Livermore Valley is divided between upland and valley floor areas, with the valley floor area comprising almost 65% of the 65,300 acres in the groundwater basin. Water quality in the basin did not meet either of CCWD's water quality objectives because the reported levels of chloride ranged from 19 to 620 mg/l with an average of 147 mg/l. Other reported water quality parameters included TDS concentrations ranging from 325 to 1,530 mg/l, with a mean of 634 mg/l, and nitrate concentrations ranging from 0 to 61 mg/l, with a mean of 13.3 mg/l.

The pumping scenario for this alternative could have provided the necessary 56,000 af of emergency water at a rate of 400 cfs. The well field would have had significant impacts on local groundwater conditions; the total drawdown from the well field pumping for 70 days could have reached as deep as 90 feet below the center of the well field. Declining water levels would have affected many shallow wells in the area, forcing them to be shut down during periods of lower water levels or replaced with deeper wells.

Recharging the groundwater basin with imported Delta water may not have proven practical. Supplementing the natural recharge would have been most effective when the streams were not recharging the groundwater basin. With natural recharge occurring in winter and spring, supplemental recharge would have been most effective in summer and fall. In contrast, Delta water quality and availability is best during winter and spring, and less acceptable as recharge water during summer and fall. This conflicting supply and

demand schedule for the Delta recharge water may eliminate it as a source of recharge water.

The estimated capital cost of this alternative was $380 million. Many of the wells (about 50%) would have had to be replaced within 20-30 years, which would have increased the cost of this alternative considerably. If the project were operated in any given year to its full capacity, associated operations and maintenance costs would have been an estimated $18.5 million. In years when no water is produced, the maintenance costs would have been an estimated $5.5 million.

The Bernal, Amador, and Mocho subbasins are currently managed and fully used by Zone 7 for water supply purposes. Arroyo Valley and Arroyo Mocho are used for recharge activities under Zone 7's management. The amount of groundwater required by CCWD could not have been obtained from Livermore Valley given Zone 7's need for and use of groundwater. Given the number of wells needed, and the spacing required to provide the necessary quantity of water, the entire valley floor area comprising the Bernal, Amador, and Mocho subbasins would have been included in the alternative. Much of the proposed well field area continues to be developed. Well sites and a collector system would have needed to be interspersed among residential and commercial developments. Project compatibility with these types of existing and proposed developments was questionable.

In addition, the groundwater basin response to CCWD operation could have resulted in adverse impacts on the existing users of the groundwater basin, particularly Zone 7. Periodic extraction and recharge of up to 56,000 af likely would have resulted in greater variations in groundwater levels than are currently experienced. Raising the groundwater table may have introduced contaminants, such as nitrates and organics, from the vadose zone into the groundwater. The response of the basin to this intensive management was unknown, and specific impacts on other users would have needed to be evaluated in detail.

The unreliable availability of resources, untested technology, and possible jurisdictional constraints associated with this alternative likely would have delayed project initiation to beyond 1995. Although the groundwater basin in the Livermore Valley had not been adjudicated or apportioned, the ability to export groundwater to Contra Costa County was highly unlikely. Currently, no state law or county ordinance exists that would prohibit the export of groundwater; however, it is possible that if any entity were to attempt to extract large quantities of groundwater for export out of the basin, an action would be filed to adjudicate the basin.

San Joaquin County Basin

The possibility of using runoff from Sierra Nevada streams tributary to the Delta to recharge the groundwater basin was reviewed in an effort to determine if costs of bringing water from the western Delta to eastern San Joaquin County could be eliminated. In 1987, CCWD pursued the purchase of excess Mokelumne River water from EBMUD. Although the contract calls for up to 50,000 af/yr of water to be available, studies indicated that even during wet years only 15,000 af of water could be purchased from EBMUD. This quantity

has been further reduced by a recent EBMUD and DFG agreement, which specifies additional Mokelumne River instream flow releases. Also, the purchase water could not be diverted to reservoir storage, but could be used only directly through existing facilities.

A potential groundwater project could have been configured at a location southeast of Stockton, which is located in eastern San Joaquin County, closest to CCWD. A second area northeast of Stockton and near Clements was rejected because the conveyance facilities would have needed to be located between the Clements site and the Contra Costa Canal and would have required crossing several Delta islands. The conveyance costs associated with the Delta crossings were significantly higher than the other two alternatives, and the conveyance system was more susceptible to disruption.

CCWD could have developed a new well field and recharge facilities. Groundwater would have been pumped and conveyed to the Contra Costa Canal to meet emergency needs or to be blended to meet water quality criteria. When the groundwater system was not being used, replenishment water would have been conveyed from the canal to the recharge area. Using U.S. Soil Conservation Service maps and DWR geologic data, a recharge area along the Stanislaus River near Oakdale was identified for this subalternative.

Based on available data from DWR, U.S. Geological Survey, and San Joaquin County Flood Control and Water Conservation District, the water quality in the proposed well field area was good and appeared to almost meet CCWD's established criteria. Reported chloride levels were below 75 mg/l, close to CCWD's goal of 65 mg/l. Other reported water quality parameters included TDS levels ranging from 175 to 600 mg/l. Sufficient groundwater was available to meet CCWD's needs.

The estimated capital cost for this alternative was $415 million. If the alternative were operated in any given year to its full capacity, associated operations and maintenance costs would have been an estimated $13.7 million. In years when no water is produced, the maintenance costs would have been an estimated $5.4 million.

Declining water levels would have affected many shallow wells in the area, forcing them either to be retired during periods of lower water levels or be replaced with deeper wells. This large drawdown would have dramatically increased the overdraft conditions already existing east of Stockton and the rate of seawater intrusion into Stockton and east San Joaquin County. Recent studies of groundwater resources in the county have confirmed an overdraft of approximately 1.5 million af during 1963-1982. Furthermore, the amount of supplemental surface water needed to restore basin groundwater levels is estimated at approximately 200,000 af/yr plus system losses (Brown and Caldwell 1985).

Recharging the groundwater basin with imported Delta water may not have proven practical. Supplementing the natural recharge would have been most effective when the streams were not recharging the groundwater basin. With natural recharge occurring in winter and spring, supplemental recharge would have been most effective in summer and fall. In contrast, Delta water quality is best during winter and spring and less acceptable as recharge water during summer and fall. This conflicting supply and demand schedule for the Delta recharge water eliminated it as a source of recharge water.

The unreliable availability of resources, untested technology, and possible jurisdictional constraints associated with this alternative likely would have delayed project initiation to beyond 1995. Discussions with San Joaquin County staff indicated that the county is implementing management controls over groundwater extraction in the valley portion of the county and is actively seeking additional water supplies, including participation in the proposed Auburn Reservoir. Legislation adopted in 1984 provides a mechanism for exporting groundwater in some areas of California, including San Joaquin County. This legislation provides that groundwater can be exported with the county board of supervisors' approval. Such approval probably would not have been granted, however, given the present groundwater overdraft problems in San Joaquin County.

Section B

Delta System Resources

Section B-1. Summary Flow Statistics for Selected Delta System Locations

Table 1. Monthly Flow Statistics for Delta Inflow under Existing Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM												
Existing conditions	449.0	0.0	691.0	0.0	733.0	0.0	728.0	0.0	652.0	0.0	679.0	0.0
LV - Old River	449.0	0.0	691.0	0.0	733.0	0.0	729.0	1.0	652.0	0.0	679.0	0.0
LV - Clifton Court	449.0	0.0	691.0	0.0	733.0	0.0	732.0	4.0	652.0	0.0	674.0	-5.0
Middle River	449.0	0.0	691.0	0.0	733.0	0.0	728.0	0.0	652.0	0.0	679.0	0.0
Desalination	456.0	7.0	693.0	2.0	734.0	1.0	728.0	0.0	653.0	1.0	681.0	2.0
MEDIAN												
Existing condition	1039.0	0.0	1085.0	0.0	1183.0	0.0	1558.0	0.0	2012.0	0.0	1744.0	0.0
LV - Old River	1039.0	0.0	1084.0	-1.0	1218.0	35.0	1558.0	0.0	2012.0	0.0	1744.0	0.0
LV - Clifton Court	1039.0	0.0	1085.0	0.0	1216.0	33.0	1558.0	0.0	2012.0	0.0	1744.0	0.0
Middle River	1039.0	0.0	1085.0	0.0	1183.0	0.0	1558.0	0.0	2012.0	0.0	1744.0	0.0
Desalination	1040.0	1.0	1086.0	1.0	1175.0	-8.0	1558.0	0.0	2012.0	0.0	1744.0	0.0
AVERAGE												
Existing condition	1100.0	0.0	1274.0	0.0	2005.0	0.0	2791.0	0.0	2970.0	0.0	2609.0	0.0
LV - Old River	1099.0	-1.0	1275.0	0.0	2007.0	1.0	2793.0	2.0	2972.0	2.0	2609.0	0.0
LV - Clifton Court	1099.0	-1.0	1275.0	0.0	2007.0	1.0	2793.0	2.0	2972.0	2.0	2609.0	0.0
Middle River	1100.0	0.0	1274.0	0.0	2005.0	0.0	2791.0	0.0	2970.0	0.0	2609.0	0.0
Desalination	1101.0	1.0	1275.0	0.0	2004.0	-1.0	2790.0	-1.0	2969.0	-1.0	2609.0	0.0
MAXIMUM												
Existing condition	2481.0	0.0	4404.0	0.0	6699.0	0.0	12899.0	0.0	9219.0	0.0	10200.0	0.0
LV - Old River	2481.0	0.0	4404.0	0.0	6699.0	0.0	12899.0	0.0	9219.0	0.0	10200.0	0.0
LV - Clifton Court	2481.0	0.0	4404.0	0.0	6699.0	0.0	12899.0	0.0	9219.0	0.0	10200.0	0.0
Middle River	2481.0	0.0	4404.0	0.0	6699.0	0.0	12899.0	0.0	9219.0	0.0	10200.0	0.0
Desalination	2480.0	-1.0	4403.0	-1.0	6699.0	0.0	12899.0	0.0	9219.0	0.0	10200.0	0.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES												
LV - Old River	1.8	7.0	10.5	8.0	19.3	6.0	10.5	14.5	15.8	6.0	1.8	16.0
LV - Clifton Court	10.5	5.5	15.8	2.0	17.5	3.5	10.5	22.0	15.8	8.0	3.5	11.5
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	63.2	1.0	49.1	1.0	31.6	1.0	8.8	1.0	12.3	1.0	17.5	1.0
DECREASES												
LV - Old River	24.6	-6.0	28.1	-3.0	10.5	-3.5	1.8	-1.0	3.5	-10.0	0.0	0.0
LV - Clifton Court	21.1	-4.5	17.5	-2.0	0.0	0.0	1.8	-1.0	5.3	-4.0	1.8	-5.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	17.5	-1.0	19.3	-2.0	24.6	-3.5	10.5	-7.0	22.8	-3.0	5.3	-2.0

	APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM												
Existing conditions	697.0	0.0	730.0	0.0	670.0	0.0	718.0	0.0	556.0	0.0	486.0	0.0
LV - Old River	697.0	0.0	730.0	0.0	670.0	0.0	718.0	0.0	547.0	-9.0	467.0	-19.0
LV - Clifton Court	697.0	0.0	730.0	0.0	670.0	0.0	715.0	-3.0	547.0	-9.0	467.0	-19.0
Middle River	697.0	0.0	730.0	0.0	670.0	0.0	718.0	0.0	556.0	0.0	486.0	0.0
Desalination	698.0	1.0	732.0	2.0	670.0	0.0	720.0	2.0	558.0	2.0	491.0	5.0
MEDIAN												
Existing condition	1321.0	0.0	1417.0	0.0	1136.0	0.0	1300.0	0.0	1029.0	0.0	759.0	0.0
LV - Old River	1321.0	0.0	1418.0	1.0	1136.0	0.0	1300.0	0.0	1029.0	0.0	759.0	0.0
LV - Clifton Court	1321.0	0.0	1417.0	0.0	1133.0	-3.0	1295.0	-5.0	1029.0	0.0	759.0	0.0
Middle River	1321.0	0.0	1417.0	0.0	1136.0	0.0	1300.0	0.0	1029.0	0.0	759.0	0.0
Desalination	1322.0	1.0	1423.0	6.0	1136.0	0.0	1301.0	1.0	1029.0	0.0	760.0	1.0
AVERAGE												
Existing condition	2010.0	0.0	1710.0	0.0	1321.0	0.0	1258.0	0.0	1020.0	0.0	791.0	0.0
LV - Old River	2010.0	0.0	1709.0	-1.0	1320.0	-1.0	1256.0	-2.0	1020.0	-1.0	790.0	-1.0
LV - Clifton Court	2010.0	0.0	1709.0	-1.0	1320.0	-1.0	1255.0	-3.0	1020.0	0.0	790.0	-1.0
Middle River	2010.0	0.0	1710.0	0.0	1321.0	0.0	1258.0	0.0	1020.0	0.0	791.0	0.0
Desalination	2010.0	0.0	1710.0	0.0	1321.0	0.0	1259.0	1.0	1021.0	1.0	792.0	1.0
MAXIMUM												
Existing condition	6989.0	0.0	4957.0	0.0	3539.0	0.0	1619.0	0.0	1342.0	0.0	1318.0	0.0
LV - Old River	6989.0	0.0	4957.0	0.0	3539.0	0.0	1619.0	0.0	1342.0	0.0	1318.0	0.0
LV - Clifton Court	6989.0	0.0	4957.0	0.0	3539.0	0.0	1619.0	0.0	1342.0	0.0	1318.0	0.0
Middle River	6989.0	0.0	4957.0	0.0	3539.0	0.0	1619.0	0.0	1342.0	0.0	1318.0	0.0
Desalination	6989.0	0.0	4957.0	0.0	3539.0	0.0	1619.0	0.0	1343.0	1.0	1318.0	0.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES												
LV - Old River	7.0	1.5	5.3	1.0	1.8	32.0	1.8	1.0	3.5	1.5	0.0	0.0
LV - Clifton Court	7.0	2.0	3.5	2.5	1.8	24.0	0.0	0.0	5.3	2.0	1.8	4.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	21.1	1.0	21.1	1.0	59.6	1.0	61.4	1.0	56.1	1.0	43.9	1.0
DECREASES												
LV - Old River	0.0	0.0	12.3	-6.0	19.3	-6.0	24.6	-7.0	12.3	-6.0	22.8	-4.0
LV - Clifton Court	0.0	0.0	17.5	-5.0	26.3	-6.0	43.9	-7.0	14.0	-1.5	17.5	-3.5
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	8.8	-1.0	5.3	-1.0	1.8	-22.0	3.5	-1.0	1.8	-1.0	5.3	-1.0

Table 2. Monthly Flow Statistics for Delta Outflow under Existing Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM												
Existing conditions	215.0	0.0	211.0	0.0	277.0	0.0	277.0	0.0	250.0	0.0	277.0	0.0
LV - Old River	215.0	0.0	211.0	0.0	277.0	0.0	277.0	0.0	250.0	0.0	277.0	0.0
LV - Clifton Court	215.0	0.0	211.0	0.0	277.0	0.0	277.0	0.0	250.0	0.0	277.0	0.0
Middle River	215.0	0.0	211.0	0.0	277.0	0.0	277.0	0.0	250.0	0.0	277.0	0.0
Desalination	215.0	0.0	211.0	0.0	277.0	0.0	277.0	0.0	250.0	0.0	277.0	0.0
MEDIAN												
Existing condition	312.0	0.0	338.0	0.0	447.0	0.0	877.0	0.0	1379.0	0.0	1000.0	0.0
LV - Old River	312.0	0.0	338.0	0.0	441.0	-6.0	866.0	-11.0	1379.0	0.0	1000.0	0.0
LV - Clifton Court	312.0	0.0	338.0	0.0	439.0	-8.0	874.0	-3.0	1379.0	0.0	1000.0	0.0
Middle River	312.0	0.0	338.0	0.0	447.0	0.0	877.0	0.0	1379.0	0.0	1000.0	0.0
Desalination	312.0	0.0	338.0	0.0	446.0	-1.0	876.0	-1.0	1379.0	0.0	1000.0	0.0
AVERAGE												
Existing condition	442.0	0.0	589.0	0.0	1237.0	0.0	2110.0	0.0	2333.0	0.0	1904.0	0.0
LV - Old River	442.0	0.0	588.0	-1.0	1237.0	0.0	2111.0	1.0	2334.0	1.0	1902.0	-1.0
LV - Clifton Court	443.0	1.0	587.0	-1.0	1237.0	0.0	2111.0	1.0	2334.0	1.0	1902.0	-2.0
Middle River	442.0	0.0	589.0	0.0	1237.0	0.0	2110.0	0.0	2333.0	0.0	1904.0	0.0
Desalination	442.0	0.0	588.0	-1.0	1236.0	-1.0	2108.0	-2.0	2331.0	-2.0	1903.0	-1.0
MAXIMUM												
Existing condition	1610.0	0.0	3588.0	0.0	5944.0	0.0	12226.0	0.0	8585.0	0.0	9519.0	0.0
LV - Old River	1610.0	0.0	3585.0	-3.0	5944.0	0.0	12229.0	3.0	8588.0	3.0	9519.0	0.0
LV - Clifton Court	1610.0	0.0	3585.0	-3.0	5944.0	0.0	12227.0	1.0	8588.0	3.0	9519.0	0.0
Middle River	1610.0	0.0	3588.0	0.0	5944.0	0.0	12226.0	0.0	8585.0	0.0	9519.0	0.0
Desalination	1609.0	-1.0	3587.0	-1.0	5943.0	-1.0	12225.0	-1.0	8584.0	-1.0	9519.0	0.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES												
LV - Old River	3.5	4.0	14.0	5.0	8.8	7.0	21.1	3.0	21.1	4.0	5.3	4.0
LV - Clifton Court	10.5	6.0	14.0	3.0	12.3	1.0	19.3	2.0	21.1	4.0	5.3	2.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	0.0	0.0	0.0	0.0	0.0	0.0	1.8	1.0	0.0	0.0	0.0	0.0
DECREASES												
LV - Old River	0.0	0.0	35.1	-4.0	22.8	-3.0	17.5	-8.0	26.3	-5.0	22.8	-7.0
LV - Clifton Court	0.0	0.0	35.1	-4.0	26.3	-3.0	21.1	-5.0	22.8	-7.0	26.3	-8.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	24.6	-1.0	35.1	-1.0	42.1	-1.5	43.9	-1.0	49.1	-1.0	38.6	-1.0

	APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM												
Existing conditions	268.0	0.0	277.0	0.0	229.0	0.0	237.0	0.0	194.0	0.0	149.0	0.0
LV - Old River	268.0	0.0	277.0	0.0	229.0	0.0	237.0	0.0	194.0	0.0	149.0	0.0
LV - Clifton Court	268.0	0.0	277.0	0.0	229.0	0.0	237.0	0.0	194.0	0.0	149.0	0.0
Middle River	268.0	0.0	277.0	0.0	229.0	0.0	237.0	0.0	194.0	0.0	149.0	0.0
Desalination	268.0	0.0	277.0	0.0	229.0	0.0	237.0	0.0	194.0	0.0	149.0	0.0
MEDIAN												
Existing condition	595.0	0.0	882.0	0.0	565.0	0.0	473.0	0.0	377.0	0.0	239.0	0.0
LV - Old River	595.0	0.0	882.0	0.0	565.0	0.0	473.0	0.0	377.0	0.0	239.0	0.0
LV - Clifton Court	595.0	0.0	882.0	0.0	565.0	0.0	473.0	0.0	376.0	-1.0	239.0	0.0
Middle River	595.0	0.0	882.0	0.0	565.0	0.0	473.0	0.0	377.0	0.0	239.0	0.0
Desalination	595.0	0.0	889.0	7.0	565.0	0.0	473.0	0.0	377.0	0.0	239.0	0.0
AVERAGE												
Existing condition	1325.0	0.0	1199.0	0.0	743.0	0.0	468.0	0.0	355.0	0.0	251.0	0.0
LV - Old River	1323.0	-2.0	1197.0	-2.0	743.0	0.0	468.0	0.0	355.0	0.0	251.0	0.0
LV - Clifton Court	1323.0	-2.0	1197.0	-1.0	743.0	0.0	468.0	0.0	355.0	0.0	251.0	0.0
Middle River	1325.0	0.0	1199.0	0.0	743.0	0.0	468.0	0.0	355.0	0.0	251.0	0.0
Desalination	1324.0	0.0	1199.0	0.0	743.0	-1.0	468.0	0.0	355.0	0.0	251.0	0.0
MAXIMUM												
Existing condition	6227.0	0.0	4435.0	0.0	2909.0	0.0	755.0	0.0	485.0	0.0	549.0	0.0
LV - Old River	6227.0	0.0	4434.0	-1.0	2907.0	-2.0	755.0	0.0	485.0	0.0	549.0	0.0
LV - Clifton Court	6227.0	0.0	4434.0	-1.0	2908.0	-1.0	755.0	0.0	485.0	0.0	549.0	0.0
Middle River	6227.0	0.0	4435.0	0.0	2909.0	0.0	755.0	0.0	485.0	0.0	549.0	0.0
Desalination	6227.0	0.0	4435.0	0.0	2908.0	-1.0	754.0	-1.0	485.0	0.0	548.0	-1.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES												
LV - Old River	0.0	0.0	0.0	0.0	1.8	19.0	5.3	1.0	1.8	1.0	0.0	0.0
LV - Clifton Court	1.8	1.0	1.8	3.0	5.3	1.0	3.5	1.0	1.8	1.0	1.8	1.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	1.8	6.0	3.5	5.5	0.0	0.0	0.0	0.0	1.8	1.0	0.0	0.0
DECREASES												
LV - Old River	28.1	-8.0	47.4	-1.0	15.8	-1.0	0.0	0.0	1.8	-1.0	0.0	0.0
LV - Clifton Court	26.3	-9.0	47.4	-1.0	14.0	-1.0	0.0	0.0	5.3	-1.0	0.0	0.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	21.1	-1.0	35.1	-1.0	12.3	-1.0	5.3	-1.0	1.8	-1.0	15.8	-1.0

Table 3. Monthly Flow statistics for the Delta Cross Channel under Existing Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM												
Existing conditions	178.2	0.0	307.1	0.0	348.0	0.0	262.1	0.0	225.0	0.0	265.4	0.0
LV - Old River	178.3	0.1	307.1	0.0	348.0	-0.1	262.2	0.1	225.0	0.0	265.4	0.0
LV - Clifton Cour	178.3	0.1	307.1	0.0	348.0	-0.1	262.1	0.1	225.1	0.1	265.4	0.0
Middle River	178.3	0.1	307.1	0.0	348.0	0.0	262.1	0.0	225.0	0.0	265.4	0.0
Desalination	182.6	4.4	308.1	1.0	348.5	0.4	262.1	0.0	225.1	0.1	265.4	0.0
MEDIAN												
Existing condition	407.9	0.0	462.4	0.0	478.9	0.0	444.3	0.0	417.4	0.0	437.1	0.0
LV - Old River	407.9	0.0	461.8	-0.7	477.8	-1.1	444.3	0.0	418.1	0.8	437.1	0.0
LV - Clifton Cour	407.9	0.0	462.4	0.0	478.9	0.0	444.3	0.0	418.0	0.7	437.1	0.0
Middle River	407.9	0.0	462.4	0.0	478.9	0.0	444.3	0.0	417.5	0.1	437.1	0.0
Desalination	408.2	0.4	462.8	0.4	476.2	-2.8	444.3	0.0	414.1	-3.3	437.1	0.0
AVERAGE												
Existing condition	419.9	0.0	473.5	0.0	494.2	0.0	472.9	0.0	434.0	0.0	458.8	0.0
LV - Old River	419.3	-0.5	473.4	0.0	494.5	0.3	473.2	0.3	434.2	0.3	458.9	0.1
LV - Clifton Cour	419.6	-0.3	473.6	0.1	494.6	0.4	473.2	0.4	434.2	0.3	458.9	0.1
Middle River	419.9	0.0	473.5	0.0	494.2	0.0	472.9	0.0	434.0	0.0	458.8	0.0
Desalination	420.3	0.4	473.6	0.1	494.1	-0.1	472.7	-0.2	433.7	-0.2	458.8	0.0
MAXIMUM												
Existing condition	670.1	0.0	654.9	0.0	741.4	0.0	948.0	0.0	831.5	0.0	948.5	0.0
LV - Old River	670.1	0.0	655.0	0.1	741.4	0.0	948.0	0.0	831.3	-0.2	948.5	0.0
LV - Clifton Cour	670.1	0.0	655.2	0.3	741.4	0.0	948.0	0.0	831.3	-0.2	948.5	0.0
Middle River	670.1	0.0	654.9	0.0	741.4	0.0	948.0	0.0	831.5	0.0	948.5	0.0
Desalination	670.1	0.0	654.9	0.0	741.4	0.0	948.0	0.0	831.2	-0.3	948.5	0.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES												
LV - Old River	12.3	0.1	40.4	0.1	29.8	0.3	28.1	0.2	36.8	0.2	24.6	0.1
LV - Clifton Cour	26.3	0.1	45.6	0.2	45.6	0.2	35.1	0.2	35.1	0.2	26.3	0.1
Middle River	15.8	0.1	10.5	0.1	5.3	0.1	10.5	0.1	10.5	0.1	1.8	0.1
Desalination	70.2	0.4	50.9	0.4	35.1	0.4	21.1	0.2	19.3	0.3	21.1	0.4
DECREASES												
LV - Old River	28.1	-2.2	29.8	-0.7	24.6	-0.2	10.5	-0.1	3.5	-3.4	1.8	-0.1
LV - Clifton Cour	19.3	-2.1	24.6	-0.8	8.8	-0.1	7.0	-0.1	5.3	-1.1	3.5	-1.4
Middle River	1.8	-0.1	7.0	-0.1	5.3	-0.1	5.3	-0.1	0.0	0.0	1.8	-0.1
Desalination	12.3	-0.3	22.8	-0.5	22.8	-0.9	14.0	-0.5	22.8	-0.5	3.5	-1.9

	APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM												
Existing conditions	246.7	0.0	313.5	0.0	298.5	0.0	322.4	0.0	249.7	0.0	213.1	0.0
LV - Old River	260.9	14.2	313.5	0.0	298.5	0.0	322.5	0.1	244.3	-5.4	200.7	-12.4
LV - Clifton Cour	260.8	14.1	313.5	0.0	298.5	0.0	322.5	0.1	243.7	-6.0	200.7	-12.5
Middle River	246.7	0.0	313.6	0.1	298.5	0.0	322.5	0.1	249.8	0.1	213.1	0.0
Desalination	246.7	0.0	313.6	0.1	298.5	0.0	323.9	1.4	250.9	1.2	215.6	2.5
MEDIAN												
Existing condition	460.3	0.0	446.9	0.0	446.2	0.0	554.7	0.0	464.9	0.0	355.0	0.0
LV - Old River	471.3	10.9	446.9	0.0	446.3	0.1	553.0	-1.7	464.9	0.0	354.5	-0.5
LV - Clifton Cour	471.3	10.9	446.9	0.0	445.9	-0.3	552.4	-2.3	464.9	0.0	354.9	-0.1
Middle River	460.3	0.0	446.9	0.0	446.2	0.0	554.7	0.0	464.9	0.0	355.0	0.0
Desalination	460.3	0.0	447.3	0.4	446.3	0.1	554.7	0.0	464.5	-0.4	355.2	0.2
AVERAGE												
Existing condition	438.6	0.0	477.1	0.0	457.9	0.0	529.0	0.0	454.4	0.0	353.8	0.0
LV - Old River	447.3	8.7	476.9	-0.2	457.6	-0.3	528.3	-0.7	454.1	-0.3	353.2	-0.6
LV - Clifton Cour	447.4	8.7	476.8	-0.2	457.4	-0.4	527.8	-1.1	454.2	-0.2	353.3	-0.5
Middle River	438.6	0.0	477.1	0.0	457.9	0.0	529.0	0.0	454.4	0.0	353.8	0.0
Desalination	438.7	0.1	477.2	0.2	457.9	0.1	529.2	0.3	454.6	0.2	354.1	0.4
MAXIMUM												
Existing condition	735.7	0.0	720.6	0.0	624.3	0.0	619.7	0.0	571.5	0.0	506.6	0.0
LV - Old River	735.7	0.0	720.6	0.0	624.3	0.0	619.7	0.0	571.5	0.0	506.7	0.1
LV - Clifton Cour	735.7	0.0	720.6	0.0	624.3	0.0	617.4	-2.3	571.5	0.0	506.7	0.1
Middle River	735.7	0.0	720.6	0.0	624.3	0.0	619.7	0.0	571.5	0.0	506.7	0.1
Desalination	735.7	0.0	720.6	0.0	624.3	0.0	619.7	0.0	571.5	0.0	506.7	0.1
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES												
LV - Old River	24.6	0.2	42.1	0.1	12.3	0.1	5.3	0.1	15.8	0.1	10.5	0.1
LV - Clifton Cour	33.3	0.1	28.1	0.1	10.5	0.1	3.5	0.1	17.5	0.1	17.5	0.1
Middle River	1.8	0.1	17.5	0.1	15.8	0.1	8.8	0.1	22.8	0.1	17.5	0.1
Desalination	35.1	0.4	47.4	0.3	56.1	0.4	57.9	0.3	59.6	0.4	49.1	0.5
DECREASES												
LV - Old River	1.8	-0.1	14.0	-2.0	19.3	-2.7	24.6	-2.4	17.5	-0.8	35.1	-1.2
LV - Clifton Cour	3.5	-0.1	19.3	-1.9	29.8	-2.5	43.9	-2.5	21.1	-0.4	26.3	-0.4
Middle River	5.3	-0.1	3.5	-0.1	5.3	-0.1	0.0	0.0	5.3	-0.1	5.3	-0.1
Desalination	12.3	-0.3	5.3	-0.2	1.8	-6.1	3.5	-0.2	3.5	-0.2	5.3	-0.4

Table 4. Monthly Storage Statistics for Shasta Reservoir under Existing Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Storage	Change	Storage	Change	Storage	Change	Storage	Change	Storage	Change	Storage	Change	Storage	Change	Storage	Change	Storage	Change	Storage	Change	Storage	Change	Storage	Change
	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF
MINIMUM																								
Existing conditions	779.0	0.0	720.0	0.0	975.0	0.0	1086.0	0.0	1197.0	0.0	1658.0	0.0	1611.0	0.0	1561.0	0.0	1336.0	0.0	968.0	0.0	816.0	0.0	825.0	0.0
LV - Old River	822.0	43.0	763.0	43.0	1022.0	47.0	1133.0	47.0	1245.0	48.0	1704.0	46.0	1640.0	29.0	1590.0	29.0	1357.0	21.0	994.0	26.0	846.0	30.0	857.0	32.0
LV - Clifton Court	820.0	41.0	762.0	42.0	1021.0	46.0	1132.0	46.0	1244.0	47.0	1703.0	45.0	1635.0	24.0	1585.0	24.0	1348.0	12.0	985.0	17.0	837.0	21.0	854.0	29.0
Middle River	779.0	0.0	720.0	0.0	975.0	0.0	1086.0	0.0	1197.0	0.0	1658.0	0.0	1611.0	0.0	1561.0	0.0	1336.0	0.0	968.0	0.0	816.0	0.0	825.0	0.0
Desalination	755.0	-24.0	693.0	-27.0	941.0	-34.0	1051.0	-35.0	1162.0	-35.0	1619.0	-39.0	1599.0	-12.0	1549.0	-12.0	1320.0	-16.0	952.0	-16.0	800.0	-16.0	805.0	-20.0
MEDIAN																								
Existing condition	2838.0	0.0	2934.0	0.0	3293.0	0.0	3346.0	0.0	3588.0	0.0	3940.0	0.0	4289.0	0.0	4405.0	0.0	3949.0	0.0	3315.0	0.0	2909.0	0.0	2856.0	0.0
LV - Old River	2838.0	0.0	2935.0	1.0	3293.0	0.0	3346.0	0.0	3588.0	0.0	3940.0	0.0	4290.0	1.0	4406.0	1.0	3949.0	0.0	3315.0	0.0	2909.0	0.0	2868.0	12.0
LV - Clifton Court	2839.0	1.0	2934.0	0.0	3293.0	0.0	3346.0	0.0	3588.0	0.0	3940.0	0.0	4290.0	1.0	4405.0	0.0	3949.0	0.0	3314.0	-1.0	2918.0	9.0	2868.0	12.0
Middle River	2838.0	0.0	2934.0	0.0	3293.0	0.0	3346.0	0.0	3588.0	0.0	3940.0	0.0	4289.0	0.0	4405.0	0.0	3949.0	0.0	3315.0	0.0	2909.0	0.0	2856.0	0.0
Desalination	2835.0	-3.0	2932.0	-2.0	3293.0	0.0	3345.0	-1.0	3588.0	0.0	3939.0	-1.0	4289.0	0.0	4404.0	-1.0	3948.0	-1.0	3314.0	-1.0	2907.0	-2.0	2854.0	-2.0
AVERAGE																								
Existing condition	2686.3	0.0	2681.2	0.0	2832.2	0.0	3060.7	0.0	3380.6	0.0	3671.3	0.0	3973.2	0.0	3991.4	0.0	3727.7	0.0	3198.8	0.0	2809.6	0.0	2746.8	0.0
LV - Old River	2697.8	11.5	2692.3	11.1	2841.8	9.6	3069.6	8.8	3387.8	7.2	3677.8	6.5	3979.6	6.4	3998.0	6.5	3734.6	6.9	3206.9	8.0	2817.8	8.1	2757.2	10.4
LV - Clifton Court	2697.6	11.3	2691.9	10.7	2841.5	9.2	3068.9	8.1	3387.3	6.8	3677.4	6.1	3979.0	5.8	3997.5	6.0	3734.5	6.8	3207.7	8.9	2818.4	8.8	2757.6	10.9
Middle River	2686.3	0.0	2681.2	0.0	2832.2	0.0	3060.7	0.0	3380.6	0.0	3671.3	0.0	3973.2	0.0	3991.4	0.0	3727.7	0.0	3198.8	0.0	2809.6	0.0	2746.8	0.0
Desalination	2679.1	-7.2	2674.2	-7.0	2825.7	-6.5	3054.4	-6.4	3375.0	-5.5	3666.0	-5.3	3967.5	-5.7	3985.9	-5.5	3722.2	-5.5	3193.1	-5.8	2803.6	-6.1	2739.9	-6.9
MAXIMUM																								
Existing condition	3400.0	0.0	3252.0	0.0	3380.0	0.0	3725.0	0.0	4552.0	0.0	4318.0	0.0	4552.0	0.0	4552.0	0.0	4552.0	0.0	4300.0	0.0	4000.0	0.0	3700.0	0.0
LV - Old River	3400.0	0.0	3252.0	0.0	3380.0	0.0	3725.0	0.0	4552.0	0.0	4318.0	0.0	4552.0	0.0	4552.0	0.0	4552.0	0.0	4300.0	0.0	4000.0	0.0	3700.0	0.0
LV - Clifton Court	3400.0	0.0	3252.0	0.0	3380.0	0.0	3725.0	0.0	4552.0	0.0	4318.0	0.0	4552.0	0.0	4552.0	0.0	4552.0	0.0	4300.0	0.0	4000.0	0.0	3700.0	0.0
Middle River	3400.0	0.0	3252.0	0.0	3380.0	0.0	3725.0	0.0	4552.0	0.0	4318.0	0.0	4552.0	0.0	4552.0	0.0	4552.0	0.0	4300.0	0.0	4000.0	0.0	3700.0	0.0
Desalination	3400.0	0.0	3252.0	0.0	3380.0	0.0	3725.0	0.0	4552.0	0.0	4318.0	0.0	4552.0	0.0	4552.0	0.0	4552.0	0.0	4300.0	0.0	4000.0	0.0	3700.0	0.0
	Freq.	Median	Freq.	Median	Freq.	Median	Freq.	Median	Freq.	Median	Freq.	Median	Freq.	Median	Freq.	Median	Freq.	Median	Freq.	Median	Freq.	Median	Freq.	Median
	(%)	(TAF)	(%)	(TAF)	(%)	(TAF)	(%)	(TAF)	(%)	(TAF)	(%)	(TAF)	(%)	(TAF)	(%)	(TAF)	(%)	(TAF)	(%)	(TAF)	(%)	(TAF)	(%)	(TAF)
INCREASES																								
LV - Old River	54.4	15.0	54.4	17.0	42.1	25.0	38.6	26.5	31.6	26.0	31.6	22.0	33.3	21.0	40.4	10.0	38.6	12.0	43.9	14.0	45.6	13.5	52.6	15.0
LV - Clifton Court	56.1	16.0	49.1	21.5	36.8	25.0	33.3	25.0	29.8	21.0	26.3	25.0	28.1	19.5	38.6	11.5	40.4	12.0	54.4	13.0	57.9	11.0	56.1	14.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DECREASES																								
LV - Old River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	-2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LV - Clifton Court	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.0.0	0.0	1.8	-1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	-1.0	0.0	0.0	0.0	0.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	73.7	-4.0	57.9	-5.0	45.6	-10.0	43.9	-9.0	38.6	-7.5	40.4	-7.0	50.9	-5.0	47.4	-6.0	63.2	-3.0	73.7	-2.0	87.7	-2.0	86.0	-3.0

Table 5. Monthly Storage Statistics for Folsom Reservoir under Existng Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF
MINIMUM																								
Existing conditions	69.0	0.0	61.0	0.0	152.0	0.0	203.0	0.0	194.0	0.0	193.0	0.0	195.0	0.0	199.0	0.0	177.0	0.0	131.0	0.0	107.0	0.0	82.0	0.0
LV - Old River	74.0	5.0	66.0	5.0	156.0	4.0	209.0	6.0	200.0	6.0	198.0	5.0	201.0	6.0	205.0	6.0	182.0	5.0	136.0	5.0	112.0	5.0	87.0	5.0
LV - Clifton Court	73.0	4.0	65.0	4.0	156.0	4.0	207.0	4.0	199.0	5.0	197.0	4.0	199.0	4.0	203.0	4.0	181.0	4.0	136.0	5.0	111.0	4.0	86.0	4.0
Middle River	69.0	0.0	61.0	0.0	152.0	0.0	203.0	0.0	194.0	0.0	193.0	0.0	195.0	0.0	199.0	0.0	177.0	0.0	131.0	0.0	107.0	0.0	82.0	0.0
Dealination	70.0	1.0	62.0	1.0	153.0	1.0	206.0	3.0	197.0	3.0	195.0	2.0	197.0	2.0	201.0	2.0	179.0	2.0	133.0	2.0	108.0	1.0	83.0	1.0
MEDIAN																								
Existing condition	556.0	0.0	549.0	0.0	610.0	0.0	619.0	0.0	686.0	0.0	794.0	0.0	969.0	0.0	1010.0	0.0	961.0	0.0	793.0	0.0	639.0	0.0	594.0	0.0
LV - Old River	556.0	0.0	554.0	5.0	610.0	0.0	619.0	0.0	686.0	0.0	794.0	0.0	969.0	0.0	1010.0	0.0	961.0	0.0	794.0	1.0	640.0	1.0	592.0	-2.0
LV - Clifton Court	556.0	0.0	553.0	4.0	610.0	0.0	619.0	0.0	687.0	1.0	794.0	0.0	969.0	0.0	1010.0	0.0	962.0	1.0	793.0	0.0	640.0	1.0	592.0	-2.0
Middle River	556.0	0.0	549.0	0.0	610.0	0.0	619.0	0.0	686.0	0.0	794.0	0.0	969.0	0.0	1010.0	0.0	961.0	0.0	793.0	0.0	639.0	0.0	594.0	0.0
Dealination	555.0	-1.0	549.0	0.0	610.0	0.0	619.0	0.0	685.0	-1.0	794.0	0.0	969.0	0.0	1010.0	0.0	961.0	0.0	793.0	0.0	635.0	-4.0	591.0	-3.0
AVERAGE																								
Existing condition	514.3	0.0	494.2	0.0	512.0	0.0	576.4	0.0	646.9	0.0	735.1	0.0	889.7	0.0	919.0	0.0	874.2	0.0	727.7	0.0	611.9	0.0	562.7	0.0
LV - Old River	515.7	1.4	495.9	1.6	513.8	1.8	577.3	0.9	647.5	0.6	735.9	0.9	890.5	0.8	919.9	1.0	875.2	1.1	729.2	1.5	613.7	1.8	563.8	1.2
LV - Clifton Court	515.7	1.4	495.8	1.6	513.8	1.8	577.3	0.8	647.3	0.5	735.8	0.7	890.4	0.7	919.9	0.9	875.3	1.1	729.5	1.7	613.9	2.0	563.8	1.1
Middle River	514.3	0.0	494.2	0.0	512.0	0.0	576.4	0.0	646.9	0.0	735.1	0.0	889.7	0.0	919.0	0.0	874.2	0.0	727.7	0.0	611.9	0.0	562.7	0.0
Dealination	513.0	-1.3	492.6	-1.7	510.3	-1.7	575.9	-0.5	646.8	-0.1	734.9	-0.2	889.7	0.0	918.8	-0.2	874.2	0.0	727.3	-0.5	611.2	-0.7	561.7	-1.0
MAXIMUM																								
Existing condition	680.0	0.0	610.0	0.0	610.0	0.0	687.0	0.0	758.0	0.0	860.0	0.0	1010.0	0.0	1010.0	0.0	1010.0	0.0	960.0	0.0	860.0	0.0	780.0	0.0
LV - Old River	680.0	0.0	610.0	0.0	610.0	0.0	687.0	0.0	758.0	0.0	860.0	0.0	1010.0	0.0	1010.0	0.0	1010.0	0.0	960.0	0.0	860.0	0.0	780.0	0.0
LV - Clifton Court	680.0	0.0	610.0	0.0	610.0	0.0	687.0	0.0	758.0	0.0	860.0	0.0	1010.0	0.0	1010.0	0.0	1010.0	0.0	960.0	0.0	860.0	0.0	780.0	0.0
Middle River	680.0	0.0	610.0	0.0	610.0	0.0	687.0	0.0	758.0	0.0	860.0	0.0	1010.0	0.0	1010.0	0.0	1010.0	0.0	960.0	0.0	860.0	0.0	780.0	0.0
Dealination	680.0	0.0	610.0	0.0	610.0	0.0	687.0	0.0	758.0	0.0	860.0	0.0	1010.0	0.0	1010.0	0.0	1010.0	0.0	960.0	0.0	860.0	0.0	780.0	0.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES																								
LV - Old River	42.1	4.0	40.4	3.0	36.8	3.0	26.3	4.0	14.0	4.0	21.1	3.0	15.8	4.0	19.3	4.0	31.6	2.5	36.8	4.0	40.4	4.0	43.9	3.0
LV - Clifton Court	50.9	3.0	38.6	4.0	35.1	3.0	24.6	3.5	15.8	3.0	21.1	2.5	15.8	4.0	19.3	1.0	35.1	2.0	52.6	2.5	52.6	4.0	50.9	3.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dealination	5.3	6.0	5.3	4.0	5.3	3.0	5.3	7.0	3.5	9.0	5.3	11.0	7.0	7.0	5.3	10.0	5.3	10.0	5.3	5.0	5.3	5.0	5.3	6.0
DECREASES																								
LV - Old River	1.8	-23.0	0.0	0.0	0.0	0.0	1.8	-19.0	0.0	0.0	1.8	-1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	-1.0	5.3	-3.0
LV - Clifton Court	1.8	-28.0	3.5	-3.0	0.0	0.0	1.8	-16.0	1.8	-1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	-17.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dealination	47.4	-1.0	43.9	-2.0	33.3	-3.0	26.3	-3.0	19.3	-1.0	19.3	-2.0	15.8	-1.0	19.3	-1.0	31.6	-1.0	45.6	-1.0	49.1	-1.0	63.2	-1.0

Table 6 Monthly Storage Statistics for Clair Engle Reservoir under Existing Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF
MINIMUM																								
Existing conditions	305.0	0.0	302.0	0.0	313.0	0.0	305.0	0.0	309.0	0.0	391.0	0.0	527.0	0.0	628.0	0.0	694.0	0.0	514.0	0.0	342.0	0.0	313.0	0.0
LV - Old River	305.0	0.0	302.0	0.0	313.0	0.0	305.0	0.0	309.0	0.0	391.0	0.0	534.0	7.0	639.0	11.0	702.0	8.0	522.0	8.0	348.0	6.0	313.0	0.0
LV - Clifton Court	305.0	0.0	302.0	0.0	313.0	0.0	305.0	0.0	309.0	0.0	391.0	0.0	534.0	7.0	639.0	11.0	702.0	8.0	523.0	9.0	348.0	6.0	313.0	0.0
Middle River	305.0	0.0	302.0	0.0	313.0	0.0	305.0	0.0	309.0	0.0	391.0	0.0	527.0	0.0	628.0	0.0	694.0	0.0	514.0	0.0	342.0	0.0	313.0	0.0
Desalination	305.0	0.0	302.0	0.0	313.0	0.0	305.0	0.0	309.0	0.0	391.0	0.0	522.0	-5.0	620.0	-8.0	685.0	-9.0	504.0	-10.0	334.0	-8.0	313.0	0.0
MEDIAN																								
Existing condition	1619.0	0.0	1600.0	0.0	1668.0	0.0	1759.0	0.0	1797.0	0.0	1890.0	0.0	1989.0	0.0	2129.0	0.0	2098.0	0.0	1927.0	0.0	1758.0	0.0	1681.0	0.0
LV - Old River	1621.0	2.0	1602.0	2.0	1669.0	1.0	1759.0	0.0	1799.0	2.0	1890.0	0.0	1997.0	8.0	2130.0	1.0	2100.0	2.0	1941.0	14.0	1775.0	17.0	1686.0	5.0
LV - Clifton Court	1621.0	2.0	1603.0	3.0	1669.0	1.0	1759.0	0.0	1799.0	2.0	1890.0	0.0	1998.0	9.0	2130.0	1.0	2100.0	2.0	1937.0	10.0	1771.0	13.0	1686.0	5.0
Middle River	1619.0	0.0	1600.0	0.0	1668.0	0.0	1759.0	0.0	1797.0	0.0	1890.0	0.0	1989.0	0.0	2129.0	0.0	2098.0	0.0	1927.0	0.0	1758.0	0.0	1681.0	0.0
Desalination	1615.0	-4.0	1596.0	-4.0	1668.0	0.0	1759.0	0.0	1797.0	0.0	1890.0	0.0	1987.0	-2.0	2127.0	-2.0	2097.0	-1.0	1926.0	-1.0	1757.0	-1.0	1671.0	-10.0
AVERAGE																								
Existing condition	1462.5	0.0	1465.0	0.0	1483.4	0.0	1563.1	0.0	1651.8	0.0	1765.1	0.0	1897.9	0.0	1989.4	0.0	1987.1	0.0	1820.5	0.0	1642.5	0.0	1538.4	0.0
LV - Old River	1464.0	1.5	1466.7	1.6	1485.2	1.8	1565.0	1.9	1653.7	1.9	1767.1	2.0	1900.1	2.2	1991.8	2.4	1989.7	2.6	1823.3	2.8	1645.3	2.8	1540.6	2.2
LV - Clifton Court	1464.0	1.5	1466.6	1.6	1485.0	1.7	1564.8	1.7	1653.5	1.7	1766.9	1.8	1899.9	2.0	1991.5	2.2	1989.5	2.4	1823.0	2.5	1645.1	2.6	1540.3	1.9
Middle River	1462.5	0.0	1465.0	0.0	1483.4	0.0	1563.1	0.0	1651.8	0.0	1765.1	0.0	1897.9	0.0	1989.4	0.0	1987.1	0.0	1820.5	0.0	1642.5	0.0	1538.4	0.0
Desalination	1461.8	-0.8	1464.2	-0.9	1482.5	-0.8	1562.2	-0.9	1650.8	-1.0	1764.0	-1.1	1896.7	-1.3	1988.0	-1.4	1985.4	-1.6	1818.8	-1.7	1640.8	-1.7	1537.2	-1.2
MAXIMUM																								
Existing condition	2040.0	0.0	2094.0	0.0	2189.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2400.0	0.0	2239.0	0.0	2133.0	0.0
LV - Old River	2040.0	0.0	2094.0	0.0	2189.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2400.0	0.0	2239.0	0.0	2133.0	0.0
LV - Clifton Court	2040.0	0.0	2094.0	0.0	2189.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2400.0	0.0	2239.0	0.0	2133.0	0.0
Middle River	2040.0	0.0	2094.0	0.0	2189.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2400.0	0.0	2239.0	0.0	2133.0	0.0
Desalination	2040.0	0.0	2093.0	-1.0	2189.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2400.0	0.0	2239.0	0.0	2133.0	0.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES																								
LV - Old River	40.4	2.0	42.1	2.0	38.6	3.5	38.6	3.0	36.8	4.0	38.6	4.0	35.1	5.0	40.4	5.0	45.6	3.5	45.6	4.0	50.9	2.0	47.4	2.0
LV - Clifton Court	49.1	2.0	40.4	3.0	40.4	3.0	40.4	3.0	40.4	3.0	42.1	3.5	40.4	4.0	43.9	3.0	47.4	3.0	47.4	3.0	56.1	2.0	50.9	2.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DECREASES																								
LV - Old River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	-1.0	1.8	-1.0	0.0	0.0	0.0	0.0	0.0	0.0
LV - Clifton Court	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	36.8	-1.0	38.6	-2.0	33.3	-2.0	33.3	-2.0	31.6	-2.0	36.8	-2.0	42.1	-2.0	38.6	-2.0	38.6	-2.0	49.1	-1.0	43.9	-2.0	42.1	-2.0

Table 7. Monthly Flow Statistics for the American River at Nimbus Dam under Existing Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM												
Existing conditions	37.0	0.0	35.0	0.0	35.0	0.0	21.0	0.0	24.2	0.0	23.0	0.0
LV - Old River	37.0	0.0	35.0	0.0	35.0	0.0	26.0	5.0	24.2	0.0	23.0	0.0
LV - Clifton Court	37.0	0.0	35.0	0.0	35.0	0.0	25.0	4.0	24.2	0.0	23.0	0.0
Middle River	37.0	0.0	35.0	0.0	35.0	0.0	21.0	0.0	24.2	0.0	23.0	0.0
Desalination	37.0	0.0	35.0	0.0	35.0	0.0	22.0	1.0	24.2	0.0	23.0	0.0
MEDIAN												
Existing condition	128.0	0.0	99.0	0.0	120.0	0.0	98.0	0.0	154.5	0.0	185.0	0.0
LV - Old River	128.0	0.0	99.0	0.0	120.0	0.0	98.0	0.0	154.5	0.0	186.0	1.0
LV - Clifton Court	128.0	0.0	99.0	0.0	120.0	0.0	98.0	0.0	154.5	0.0	186.0	1.0
Middle River	128.0	0.0	99.0	0.0	120.0	0.0	98.0	0.0	154.5	0.0	185.0	0.0
Desalination	128.0	0.0	100.0	1.0	118.0	-2.0	98.0	0.0	154.5	0.0	181.0	-4.0
AVERAGE												
Existing condition	123.7	0.0	133.0	0.0	207.0	0.0	232.8	0.0	222.1	0.0	237.7	0.0
LV - Old River	123.4	-0.3	132.7	-0.3	207.0	0.0	233.7	0.9	222.4	0.3	237.3	-0.3
LV - Clifton Court	123.5	-0.3	132.8	-0.2	206.9	-0.1	233.8	0.9	222.5	0.3	237.4	-0.2
Middle River	123.7	0.0	133.0	0.0	207.0	0.0	232.8	0.0	222.1	0.0	237.7	0.0
Desalination	124.2	0.5	133.4	0.4	207.0	0.0	231.6	-1.2	221.7	-0.4	237.7	0.1
MAXIMUM												
Existing condition	301.0	0.0	853.0	0.0	1110.0	0.0	1279.0	0.0	795.0	0.0	930.0	0.0
LV - Old River	301.0	0.0	853.0	0.0	1114.0	4.0	1279.0	0.0	795.0	0.0	930.0	0.0
LV - Clifton Court	301.0	0.0	853.0	0.0	1112.0	2.0	1279.0	0.0	795.0	0.0	930.0	0.0
Middle River	301.0	0.0	853.0	0.0	1110.0	0.0	1279.0	0.0	795.0	0.0	930.0	0.0
Desalination	301.0	0.0	853.0	0.0	1107.0	-3.0	1279.0	0.0	795.0	0.0	930.0	0.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES												
LV - Old River	1.8	12.0	12.3	4.0	14.0	2.5	8.8	5.0	14.0	3.4	3.5	1.5
LV - Clifton Court	8.8	1.0	17.5	2.0	15.8	1.0	12.3	4.0	12.3	3.8	5.3	1.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	24.6	1.0	22.8	1.0	14.0	1.0	5.3	1.0	8.8	1.0	7.0	3.0
DECREASES												
LV - Old River	21.1	-2.0	17.5	-1.0	8.8	-4.0	1.8	-15.0	1.8	-19.0	8.8	-3.0
LV - Clifton Court	19.3	-1.0	12.3	-2.0	8.8	-4.0	3.5	-8.0	1.8	-17.0	8.8	-3.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	0.0	0.0	8.8	-1.0	15.8	-2.0	8.8	-7.0	15.8	-2.9	5.3	-4.0

	APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM												
Existing conditions	21.0	0.0	25.0	0.0	27.0	0.0	32.0	0.0	29.0	0.0	34.0	0.0
LV - Old River	21.0	0.0	25.0	0.0	27.0	0.0	32.0	0.0	29.0	0.0	34.0	0.0
LV - Clifton Court	21.0	0.0	25.0	0.0	27.0	0.0	32.0	0.0	29.0	0.0	34.0	0.0
Middle River	21.0	0.0	25.0	0.0	27.0	0.0	32.0	0.0	29.0	0.0	34.0	0.0
Desalination	21.0	0.0	25.0	0.0	27.0	0.0	33.0	1.0	29.0	0.0	34.0	0.0
MEDIAN												
Existing condition	150.0	0.0	297.0	0.0	209.0	0.0	229.0	0.0	195.0	0.0	130.0	0.0
LV - Old River	151.0	1.0	301.0	4.0	209.0	0.0	229.0	0.0	195.0	0.0	130.0	0.0
LV - Clifton Court	151.0	1.0	300.0	3.0	209.0	0.0	229.0	0.0	195.0	0.0	130.0	0.0
Middle River	150.0	0.0	297.0	0.0	209.0	0.0	229.0	0.0	195.0	0.0	130.0	0.0
Desalination	149.0	-1.0	301.0	4.0	209.0	0.0	229.0	0.0	195.0	0.0	130.0	0.0
AVERAGE												
Existing condition	189.9	0.0	311.1	0.0	241.8	0.0	224.9	0.0	177.0	0.0	118.7	0.0
LV - Old River	190.1	0.1	310.9	-0.2	241.8	0.0	224.4	-0.5	176.6	-0.3	119.3	0.7
LV - Clifton Court	190.0	0.0	310.8	-0.3	241.6	-0.2	224.1	-0.8	176.7	-0.2	119.6	0.9
Middle River	189.9	0.0	311.1	0.0	241.8	0.0	224.9	0.0	177.0	0.0	118.7	0.0
Desalination	189.7	-0.2	311.2	0.1	241.6	-0.1	225.4	0.5	177.2	0.2	118.9	0.2
MAXIMUM												
Existing condition	523.0	0.0	910.0	0.0	635.0	0.0	361.0	0.0	281.0	0.0	184.0	0.0
LV - Old River	523.0	0.0	910.0	0.0	635.0	0.0	361.0	0.0	281.0	0.0	184.0	0.0
LV - Clifton Court	523.0	0.0	910.0	0.0	635.0	0.0	361.0	0.0	281.0	0.0	184.0	0.0
Middle River	523.0	0.0	910.0	0.0	635.0	0.0	361.0	0.0	281.0	0.0	184.0	0.0
Desalination	523.0	0.0	910.0	0.0	635.0	0.0	361.0	0.0	281.0	0.0	184.0	0.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES												
LV - Old River	10.5	1.5	5.3	1.0	1.8	23.0	7.0	1.5	0.0	0.0	5.3	11.0
LV - Clifton Court	8.8	1.0	3.5	2.0	1.8	23.0	5.3	2.0	3.5	1.0	8.8	11.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	10.5	1.0	10.5	1.0	19.3	1.0	24.6	1.0	21.1	1.0	19.3	1.0
DECREASES												
LV - Old River	3.5	-3.0	15.8	-1.0	26.3	-1.0	29.8	-2.0	12.3	-2.0	17.5	-1.5
LV - Clifton Court	3.5	-3.0	19.3	-1.0	28.1	-2.0	43.9	-2.0	12.3	-1.0	8.8	-1.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	12.3	-1.0	3.5	-1.0	1.8	-22.0	3.5	-2.0	1.8	-3.0	1.8	-4.0

Table 8.. Monthly flow Statistics for the Trinity River at Lewiston Dam under Existing Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM												
Existing conditions	14.0	0.0	14.0	0.0	9.0	0.0	9.0	0.0	8.7	0.0	9.0	0.0
LV - Old River	14.0	0.0	14.0	0.0	9.0	0.0	9.0	0.0	8.7	0.0	9.0	0.0
LV - Clifton Court	14.0	0.0	14.0	0.0	9.0	0.0	9.0	0.0	8.7	0.0	9.0	0.0
Middle River	14.0	0.0	14.0	0.0	9.0	0.0	9.0	0.0	8.7	0.0	9.0	0.0
Desalination	14.0	0.0	14.0	0.0	9.0	0.0	9.0	0.0	8.7	0.0	9.0	0.0
MEDIAN												
Existing condition	18.0	0.0	18.0	0.0	18.0	0.0	18.0	0.0	16.4	0.0	28.0	0.0
LV - Old River	18.0	0.0	18.0	0.0	18.0	0.0	18.0	0.0	16.4	0.0	28.0	0.0
LV - Clifton Court	18.0	0.0	18.0	0.0	18.0	0.0	18.0	0.0	16.4	0.0	28.0	0.0
Middle River	18.0	0.0	18.0	0.0	18.0	0.0	18.0	0.0	16.4	0.0	28.0	0.0
Desalination	18.0	0.0	18.0	0.0	18.0	0.0	18.0	0.0	16.4	0.0	28.0	0.0
AVERAGE												
Existing condition	17.6	0.0	17.6	0.0	17.1	0.0	18.5	0.0	15.8	0.0	25.2	0.0
LV - Old River	17.6	0.0	17.6	0.0	17.1	0.0	18.5	0.0	15.8	0.0	25.2	0.0
LV - Clifton Court	17.6	0.0	17.6	0.0	17.1	0.0	18.5	0.0	15.8	0.0	25.2	0.0
Middle River	17.6	0.0	17.6	0.0	17.1	0.0	18.5	0.0	15.8	0.0	25.2	0.0
Desalination	17.6	0.0	17.6	0.0	17.1	0.0	18.5	0.0	15.8	0.0	25.2	0.0
MAXIMUM												
Existing condition	18.0	0.0	18.0	0.0	18.0	0.0	97.0	0.0	17.0	0.0	48.0	0.0
LV - Old River	18.0	0.0	18.0	0.0	18.0	0.0	97.0	0.0	17.0	0.0	48.0	0.0
LV - Clifton Court	18.0	0.0	18.0	0.0	18.0	0.0	97.0	0.0	17.0	0.0	48.0	0.0
Middle River	18.0	0.0	18.0	0.0	18.0	0.0	97.0	0.0	17.0	0.0	48.0	0.0
Desalination	18.0	0.0	18.0	0.0	18.0	0.0	97.0	0.0	17.0	0.0	48.0	0.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES												
LV - Old River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LV - Clifton Court	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DECREASES												
LV - Old River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LV - Clifton Court	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM												
Existing conditions	9.0	0.0	9.0	0.0	15.0	0.0	16.0	0.0	15.0	0.0	12.0	0.0
LV - Old River	9.0	0.0	9.0	0.0	15.0	0.0	16.0	0.0	15.0	0.0	12.0	0.0
LV - Clifton Court	9.0	0.0	9.0	0.0	15.0	0.0	16.0	0.0	15.0	0.0	12.0	0.0
Middle River	9.0	0.0	9.0	0.0	15.0	0.0	16.0	0.0	15.0	0.0	12.0	0.0
Desalination	9.0	0.0	9.0	0.0	15.0	0.0	16.0	0.0	15.0	0.0	12.0	0.0
MEDIAN												
Existing condition	36.0	0.0	55.0	0.0	46.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
LV - Old River	36.0	0.0	55.0	0.0	46.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
LV - Clifton Court	36.0	0.0	55.0	0.0	46.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
Middle River	36.0	0.0	55.0	0.0	46.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
Desalination	36.0	0.0	55.0	0.0	46.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
AVERAGE												
Existing condition	34.0	0.0	66.2	0.0	42.8	0.0	34.5	0.0	25.4	0.0	17.4	0.0
LV - Old River	34.0	0.0	66.2	0.0	42.8	0.0	34.5	0.0	25.4	0.0	17.4	0.0
LV - Clifton Court	34.0	0.0	66.2	0.0	42.8	0.0	34.5	0.0	25.4	0.0	17.4	0.0
Middle River	34.0	0.0	66.2	0.0	42.8	0.0	34.5	0.0	25.4	0.0	17.4	0.0
Desalination	34.0	0.0	66.2	0.0	42.8	0.0	34.5	0.0	25.4	0.0	17.4	0.0
MAXIMUM												
Existing condition	114.0	0.0	348.0	0.0	137.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
LV - Old River	116.0	2.0	348.0	0.0	137.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
LV - Clifton Court	116.0	2.0	348.0	0.0	137.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
Middle River	114.0	0.0	348.0	0.0	137.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
Desalination	112.0	-2.0	348.0	0.0	137.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES												
LV - Old River	1.8	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LV - Clifton Court	1.8	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DECREASES												
LV - Old River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LV - Clifton Court	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	1.8	-2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 9. Monthly Flow Statistics for the Sacramento River at Keswick Dam under Existing Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change
	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF
MINIMUM												
Existing conditions	193.0	0.0	232.0	0.0	123.0	0.0	123.0	0.0	107.0	0.0	141.0	0.0
LV - Old River	193.0	0.0	232.0	0.0	123.0	0.0	123.0	0.0	107.0	0.0	141.0	0.0
LV - Clifton Court	193.0	0.0	232.0	0.0	123.0	0.0	123.0	0.0	107.0	0.0	141.0	0.0
Middle River	193.0	0.0	232.0	0.0	123.0	0.0	123.0	0.0	107.0	0.0	141.0	0.0
Desalination	200.0	7.0	232.0	0.0	123.0	0.0	123.0	0.0	107.0	0.0	141.0	0.0
MEDIAN												
Existing condition	322.0	0.0	325.0	0.0	333.0	0.0	230.0	0.0	263.0	0.0	320.0	0.0
LV - Old River	322.0	0.0	326.0	1.0	333.0	0.0	229.0	-1.0	263.0	0.0	320.0	0.0
LV - Clifton Court	322.0	0.0	326.0	1.0	333.0	0.0	229.0	-1.0	263.0	0.0	320.0	0.0
Middle River	322.0	0.0	325.0	0.0	333.0	0.0	230.0	0.0	263.0	0.0	320.0	0.0
Desalination	323.0	1.0	328.0	3.0	333.0	0.0	230.0	0.0	263.0	0.0	320.0	0.0
AVERAGE												
Existing condition	366.0	0.0	381.0	0.0	470.0	0.0	527.0	0.0	512.0	0.0	508.0	0.0
LV - Old River	366.0	-1.0	381.0	0.0	472.0	1.0	528.0	1.0	513.0	2.0	509.0	1.0
LV - Clifton Court	366.0	0.0	381.0	1.0	472.0	1.0	528.0	1.0	513.0	2.0	509.0	1.0
Middle River	366.0	0.0	381.0	0.0	470.0	0.0	527.0	0.0	512.0	0.0	508.0	0.0
Desalination	367.0	0.0	380.0	0.0	470.0	-1.0	527.0	0.0	511.0	-1.0	508.0	0.0
MAXIMUM												
Existing condition	703.0	0.0	1823.0	0.0	1411.0	0.0	3226.0	0.0	1808.0	0.0	2753.0	0.0
LV - Old River	703.0	0.0	1823.0	0.0	1414.0	3.0	3226.0	0.0	1808.0	0.0	2753.0	0.0
LV - Clifton Court	703.0	0.0	1823.0	0.0	1414.0	3.0	3226.0	0.0	1808.0	0.0	2753.0	0.0
Middle River	703.0	0.0	1823.0	0.0	1411.0	0.0	3226.0	0.0	1808.0	0.0	2753.0	0.0
Desalination	703.0	0.0	1822.0	-1.0	1407.0	-4.0	3226.0	0.0	1808.0	0.0	2753.0	0.0
	Freq.	Median	Freq.	Median	Freq.	Median	Freq.	Median	Freq.	Median	Freq.	Median
	(%)	(TAF)	(%)	(TAF)	(%)	(TAF)	(%)	(TAF)	(%)	(TAF)	(%)	(TAF)
INCREASES												
LV - Old River	8.8	2.0	17.5	5.0	24.6	3.0	7.0	8.0	10.5	15.9	14.0	1.5
LV - Clifton Court	12.3	5.0	21.1	3.5	21.1	5.0	5.3	15.0	12.3	6.7	12.3	1.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	43.9	1.0	31.6	1.0	21.1	1.0	14.0	1.0	3.5	4.8	12.3	1.0
DECREASES												
LV - Old River	21.1	-4.5	22.8	-3.0	14.0	-2.0	3.5	-1.5	1.8	-1.0	5.3	-1.0
LV - Clifton Court	22.8	-3.0	17.5	-2.0	5.3	-1.0	3.5	-1.5	3.5	-1.0	7.0	-1.5
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	10.5	-1.0	21.1	-2.0	24.6	-3.0	7.0	-8.5	12.3	-3.9	8.8	-4.0

	APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change
	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF
MINIMUM												
Existing conditions	137.0	0.0	141.0	0.0	408.0	0.0	577.0	0.0	436.0	0.0	167.0	0.0
LV - Old River	137.0	0.0	141.0	0.0	404.0	-4.0	577.0	0.0	436.0	0.0	167.0	0.0
LV - Clifton Court	137.0	0.0	141.0	0.0	403.0	-5.0	567.0	-10.0	436.0	0.0	167.0	0.0
Middle River	137.0	0.0	141.0	0.0	408.0	0.0	577.0	0.0	436.0	0.0	167.0	0.0
Desalination	137.0	0.0	141.0	0.0	408.0	0.0	583.0	6.0	436.0	0.0	167.0	0.0
MEDIAN												
Existing condition	398.0	0.0	519.0	0.0	670.0	0.0	932.0	0.0	707.0	0.0	355.0	0.0
LV - Old River	398.0	0.0	519.0	0.0	669.0	-1.0	932.0	0.0	708.0	1.0	350.0	-5.0
LV - Clifton Court	398.0	0.0	519.0	0.0	667.0	-3.0	932.0	0.0	707.0	0.0	352.0	-3.0
Middle River	398.0	0.0	519.0	0.0	670.0	0.0	932.0	0.0	707.0	0.0	355.0	0.0
Desalination	398.0	0.0	519.0	0.0	670.0	0.0	933.0	1.0	708.0	1.0	355.0	0.0
AVERAGE												
Existing condition	461.0	0.0	559.0	0.0	648.0	0.0	908.0	0.0	743.0	0.0	360.0	0.0
LV - Old River	461.0	0.0	559.0	0.0	647.0	-1.0	907.0	-1.0	743.0	0.0	358.0	-2.0
LV - Clifton Court	461.0	0.0	559.0	0.0	647.0	-1.0	906.0	-2.0	743.0	0.0	358.0	-2.0
Middle River	461.0	0.0	559.0	0.0	648.0	0.0	908.0	0.0	743.0	0.0	360.0	0.0
Desalination	462.0	0.0	559.0	0.0	648.0	0.0	908.0	0.0	743.0	0.0	360.0	1.0
MAXIMUM												
Existing condition	1778.0	0.0	1060.0	0.0	853.0	0.0	1113.0	0.0	995.0	0.0	671.0	0.0
LV - Old River	1778.0	0.0	1060.0	0.0	853.0	0.0	1113.0	0.0	995.0	0.0	671.0	0.0
LV - Clifton Court	1778.0	0.0	1060.0	0.0	853.0	0.0	1113.0	0.0	995.0	0.0	671.0	0.0
Middle River	1778.0	0.0	1060.0	0.0	853.0	0.0	1113.0	0.0	995.0	0.0	671.0	0.0
Desalination	1778.0	0.0	1060.0	0.0	854.0	1.0	1113.0	0.0	996.0	1.0	671.0	0.0
	Freq.	Median	Freq.	Median	Freq.	Median	Freq.	Median	Freq.	Median	Freq.	Median
	(%)	(TAF)	(%)	(TAF)	(%)	(TAF)	(%)	(TAF)	(%)	(TAF)	(%)	(TAF)
INCREASES												
LV - Old River	1.8	5.0	7.0	1.0	7.0	1.0	8.8	2.0	10.5	1.0	1.8	1.0
LV - Clifton Court	3.5	3.0	5.3	1.0	5.3	1.0	7.0	2.5	7.0	1.5	3.5	3.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	17.5	1.0	12.3	1.0	21.1	1.0	26.3	1.0	40.4	1.0	33.3	1.0
DECREASES												
LV - Old River	5.3	-2.0	14.0	-4.0	19.3	-5.0	26.3	-5.0	8.8	-3.0	28.1	-2.5
LV - Clifton Court	5.3	-1.0	15.8	-4.0	26.3	-5.0	42.1	-6.0	14.0	-1.0	17.5	-7.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	3.5	-3.5	3.5	-1.0	7.0	-1.5	10.5	-1.5	5.3	-1.0	5.3	-1.0

Table 10. Monthly Flow Statistics for the Sacramento River at Sacramento under Existing Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM																								
Existing conditions	285.0	0.0	518.0	0.0	606.0	0.0	588.0	0.0	503.0	0.0	445.0	0.0	410.0	0.0	508.0	0.0	462.0	0.0	504.0	0.0	370.0	0.0	334.0	0.0
LV - Old River	285.0	0.0	518.0	0.0	606.0	0.0	589.0	1.0	503.0	0.0	445.0	0.0	410.0	0.0	508.0	0.0	462.0	0.0	504.0	0.0	361.0	-9.0	314.0	-20.0
LV - Clifton Court	285.0	0.0	518.0	0.0	606.0	0.0	592.0	4.0	503.0	0.0	440.0	-5.0	410.0	0.0	508.0	0.0	462.0	0.0	504.0	0.0	360.0	-10.0	314.0	-20.0
Middle River	285.0	0.0	518.0	0.0	606.0	0.0	588.0	0.0	503.0	0.0	445.0	0.0	410.0	0.0	508.0	0.0	462.0	0.0	504.0	0.0	370.0	0.0	334.0	0.0
Desalination	292.0	7.0	520.0	2.0	607.0	1.0	588.0	0.0	503.0	0.0	446.0	1.0	410.0	0.0	508.0	0.0	462.0	0.0	507.0	3.0	372.0	2.0	338.0	4.0
MEDIAN																								
Existing condition	784.0	0.0	905.0	0.0	973.0	0.0	1141.0	0.0	1574.0	0.0	1367.0	0.0	1096.0	0.0	1062.0	0.0	906.0	0.0	1120.0	0.0	858.0	0.0	606.0	0.0
LV - Old River	779.0	-5.0	903.0	-2.0	973.0	0.0	1146.0	5.0	1575.0	1.0	1367.0	0.0	1096.0	0.0	1062.0	0.0	906.0	0.0	1114.0	-6.0	858.0	0.0	603.0	-3.0
LV - Clifton Court	784.0	0.0	905.0	0.0	973.0	0.0	1146.0	5.0	1574.0	0.0	1367.0	0.0	1096.0	0.0	1063.0	1.0	906.0	0.0	1112.0	-8.0	858.0	0.0	606.0	0.0
Middle River	784.0	0.0	905.0	0.0	973.0	0.0	1141.0	0.0	1574.0	0.0	1367.0	0.0	1096.0	0.0	1062.0	0.0	906.0	0.0	1120.0	0.0	858.0	0.0	606.0	0.0
Desalination	785.0	1.0	906.0	1.0	974.0	1.0	1141.0	0.0	1573.0	-1.0	1367.0	0.0	1096.0	0.0	1061.0	-1.0	907.0	1.0	1120.0	0.0	857.0	-1.0	608.0	2.0
AVERAGE																								
Existing condition	822.0	0.0	1032.0	0.0	1455.0	0.0	1821.0	0.0	1908.0	0.0	1882.0	0.0	1408.0	0.0	1373.0	0.0	1027.0	0.0	1058.0	0.0	846.0	0.0	617.0	0.0
LV - Old River	820.0	-1.0	1032.0	0.0	1456.0	1.0	1823.0	2.0	1910.0	2.0	1883.0	0.0	1408.0	0.0	1372.0	-1.0	1026.0	-1.0	1056.0	-2.0	845.0	-1.0	616.0	-1.0
LV - Clifton Court	821.0	0.0	1032.0	0.0	1456.0	1.0	1823.0	2.0	1910.0	2.0	1883.0	0.0	1408.0	0.0	1372.0	-1.0	1026.0	-1.0	1054.0	-3.0	845.0	0.0	617.0	-1.0
Middle River	822.0	0.0	1032.0	0.0	1455.0	0.0	1821.0	0.0	1908.0	0.0	1882.0	0.0	1408.0	0.0	1373.0	0.0	1027.0	0.0	1058.0	0.0	846.0	0.0	617.0	0.0
Desalination	822.0	1.0	1032.0	0.0	1454.0	-1.0	1820.0	-1.0	1907.0	-1.0	1882.0	0.0	1408.0	0.0	1373.0	0.0	1027.0	0.0	1058.0	1.0	846.0	1.0	618.0	1.0
MAXIMUM																								
Existing condition	1584.0	0.0	3333.0	0.0	4234.0	0.0	5678.0	0.0	4714.0	0.0	5664.0	0.0	4163.0	0.0	4030.0	0.0	2435.0	0.0	1339.0	0.0	1177.0	0.0	1052.0	0.0
LV - Old River	1584.0	0.0	3333.0	0.0	4234.0	0.0	5678.0	0.0	4713.0	-1.0	5664.0	0.0	4163.0	0.0	4030.0	0.0	2435.0	0.0	1339.0	0.0	1177.0	0.0	1052.0	0.0
LV - Clifton Court	1584.0	0.0	3333.0	0.0	4234.0	0.0	5678.0	0.0	4713.0	-1.0	5664.0	0.0	4163.0	0.0	4030.0	0.0	2435.0	0.0	1332.0	-7.0	1177.0	0.0	1052.0	0.0
Middle River	1584.0	0.0	3333.0	0.0	4234.0	0.0	5678.0	0.0	4714.0	0.0	5664.0	0.0	4163.0	0.0	4030.0	0.0	2435.0	0.0	1339.0	0.0	1177.0	0.0	1052.0	0.0
Desalination	1584.0	0.0	3332.0	-1.0	4234.0	0.0	5678.0	0.0	4712.0	-2.0	5664.0	0.0	4163.0	0.0	4030.0	0.0	2435.0	0.0	1339.0	0.0	1177.0	0.0	1052.0	0.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES																								
LV - Old River	3.5	4.5	10.5	8.0	17.5	5.5	12.3	4.0	19.3	4.8	3.5	8.5	5.3	2.0	3.5	2.5	1.8	32.0	1.8	1.0	3.5	2.0	1.8	1.0
LV - Clifton Court	10.5	6.0	12.3	5.0	19.3	2.0	12.3	19.0	15.8	7.8	1.8	22.0	8.8	1.0	3.5	2.5	1.8	25.0	0.0	0.0	5.3	2.0	3.5	3.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	63.2	1.0	45.6	1.0	29.8	1.0	12.3	1.0	12.3	1.0	15.8	1.0	29.8	1.0	24.6	1.0	43.9	1.0	47.4	1.0	54.4	1.0	40.4	2.0
DECREASES																								
LV - Old River	26.3	-5.0	24.6	-3.5	12.3	-3.0	1.8	-1.0	3.5	-10.5	0.0	0.0	0.0	0.0	12.3	-5.0	19.3	-7.0	24.6	-7.0	10.5	-6.5	26.3	-3.0
LV - Clifton Court	19.3	-5.0	19.3	-2.0	3.5	-1.0	1.8	-1.0	5.3	-3.0	1.8	-5.0	0.0	0.0	17.5	-5.0	26.3	-6.0	42.1	-8.0	14.0	-2.0	15.8	-5.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	12.3	-1.0	19.3	-2.0	21.1	-4.5	12.3	-4.0	21.1	-3.4	3.5	-6.5	12.3	-1.0	5.3	-1.0	1.8	-21.0	1.8	-1.0	1.8	-1.0	3.5	-1.0

Table 11. Monthly Flow Statistics for Delta Inflow under Future Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM												
Existing condition	449.0	0.0	691.0	0.0	733.0	0.0	728.0	0.0	652.0	0.0	679.0	0.0
Future conditions												
No project	462.0	13.0	618.0	-73.0	752.0	19.0	774.0	46.0	689.0	37.0	586.0	-93.0
LV - Old River	462.0	13.0	618.0	-73.0	748.0	15.0	774.0	46.0	689.0	37.0	586.0	-93.0
LV - Clifton Court	462.0	13.0	611.0	-80.0	752.0	19.0	773.0	45.0	689.0	37.0	586.0	-93.0
Middle River	462.0	13.0	618.0	-73.0	752.0	19.0	774.0	46.0	689.0	37.0	586.0	-93.0
Desalination	468.0	19.0	620.0	-71.0	753.0	20.0	775.0	47.0	690.0	38.0	587.0	-92.0
MEDIAN												
Existing condition	1039.0	0.0	1085.0	0.0	1183.0	0.0	1558.0	0.0	2012.0	0.0	1744.0	0.0
Future conditions												
No project	861.0	-178.0	1045.0	-40.0	1206.0	23.0	1594.0	36.0	2055.0	43.0	1716.0	-28.0
LV - Old River	861.0	-178.0	1045.0	-40.0	1206.0	23.0	1594.0	36.0	2055.0	43.0	1716.0	-28.0
LV - Clifton Court	861.0	-178.0	1045.0	-40.0	1206.0	23.0	1594.0	36.0	2055.0	43.0	1716.0	-28.0
Middle River	861.0	-178.0	1045.0	-40.0	1206.0	23.0	1594.0	36.0	2055.0	43.0	1716.0	-28.0
Desalination	861.0	-178.0	1046.0	-39.0	1206.0	23.0	1594.0	36.0	2055.0	43.0	1716.0	-28.0
AVERAGE												
Existing condition	1100.0	0.0	1274.0	0.0	2005.0	0.0	2791.0	0.0	2970.0	0.0	2609.0	0.0
Future conditions												
No project	989.0	-111.0	1147.0	-128.0	1825.0	-180.0	2713.0	-79.0	2885.0	-85.0	2582.0	-27.0
LV - Old River	987.0	-113.0	1147.0	-128.0	1827.0	-178.0	2714.0	-78.0	2887.0	-83.0	2582.0	-26.0
LV - Clifton Court	987.0	-113.0	1147.0	-128.0	1828.0	-177.0	2714.0	-77.0	2887.0	-83.0	2582.0	-26.0
Middle River	989.0	-111.0	1147.0	-128.0	1825.0	-180.0	2713.0	-79.0	2885.0	-85.0	2582.0	-27.0
Desalination	990.0	-110.0	1147.0	-127.0	1823.0	-182.0	2713.0	-79.0	2883.0	-87.0	2582.0	-27.0
MAXIMUM												
Existing condition	2481.0	0.0	4404.0	0.0	6699.0	0.0	12899.0	0.0	9219.0	0.0	10200.0	0.0
Future conditions												
No project	2286.0	-195.0	3088.0	-1316	5955.0	-744.0	12773.0	-126.0	9032.0	-187.0	9938.0	-262.0
LV - Old River	2286.0	-195.0	3107.0	-1297	5955.0	-744.0	12773.0	-126.0	9032.0	-187.0	9938.0	-262.0
LV - Clifton Court	2286.0	-195.0	3088.0	-1316	5955.0	-744.0	12773.0	-126.0	9032.0	-187.0	9938.0	-262.0
Middle River	2286.0	-195.0	3088.0	-1316	5955.0	-744.0	12773.0	-126.0	9032.0	-187.0	9938.0	-262.0
Desalination	2285.0	-196.0	3085.0	-1319	5955.0	-744.0	12773.0	-126.0	9032.0	-187.0	9938.0	-262.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES												
No project	7.0	13.0	14.0	49.5	24.6	66.5	33.3	78.0	42.1	31.5	49.1	37.0
LV - Old River	7.0	13.0	12.3	50.0	24.6	66.0	33.3	78.0	42.1	31.5	49.1	37.0
LV - Clifton Court	7.0	13.0	14.0	49.5	24.6	66.5	33.3	78.0	42.1	31.5	49.1	37.0
Middle River	7.0	13.0	14.0	49.5	24.6	66.5	33.3	78.0	42.1	31.5	49.1	37.0
Desalination	7.0	16.0	17.5	38.5	28.1	56.0	33.3	79.0	42.1	27.0	49.1	37.0
DECREASES												
No project	93.0	-117.0	82.5	-78.0	70.2	-180.0	66.7	-125.0	57.9	-103.0	50.9	-68.0
LV - Old River	93.0	-117.0	84.2	-73.0	70.2	-180.5	66.7	-125.0	57.9	-103.0	50.9	-68.0
LV - Clifton Court	93.0	-117.0	82.5	-78.0	70.2	-180.5	66.7	-125.0	57.9	-103.0	50.9	-68.0
Middle River	93.0	-117.0	82.5	-78.0	70.2	-180.0	66.7	-125.0	57.9	-103.0	50.9	-68.0
Desalination	93.0	-118.0	82.5	-76.0	70.2	-178.5	66.7	-125.0	57.9	-103.0	50.9	-67.0

	APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM												
Existing condition	697.0	0.0	730.0	0.0	670.0	0.0	718.0	0.0	556.0	0.0	486.0	0.0
Future conditions												
No project	604.0	-93.0	685.0	-45.0	600.0	-70.0	639.0	-79.0	524.0	-32.0	522.0	36.0
LV - Old River	604.0	-93.0	685.0	-45.0	600.0	-70.0	639.0	-79.0	524.0	-32.0	522.0	36.0
LV - Clifton Court	604.0	-93.0	685.0	-45.0	600.0	-70.0	639.0	-79.0	524.0	-32.0	522.0	36.0
Middle River	604.0	-93.0	685.0	-45.0	600.0	-70.0	639.0	-79.0	524.0	-32.0	522.0	36.0
Desalination	605.0	-92.0	685.0	-45.0	603.0	-67.0	641.0	-77.0	524.0	-32.0	522.0	36.0
MEDIAN												
Existing condition	1321.0	0.0	1417.0	0.0	1136.0	0.0	1300.0	0.0	1029.0	0.0	759.0	0.0
Future conditions												
No project	1317.0	-4.0	1208.0	-209.0	1149.0	13.0	1318.0	18.0	1149.0	120.0	998.0	239.0
LV - Old River	1317.0	-4.0	1208.0	-209.0	1149.0	13.0	1318.0	18.0	1148.0	119.0	998.0	239.0
LV - Clifton Court	1317.0	-4.0	1208.0	-209.0	1147.0	11.0	1317.0	17.0	1148.0	119.0	998.0	239.0
Middle River	1317.0	-4.0	1208.0	-209.0	1149.0	13.0	1318.0	18.0	1149.0	120.0	998.0	239.0
Desalination	1317.0	-4.0	1209.0	-208.0	1150.0	14.0	1319.0	19.0	1151.0	122.0	999.0	240.0
AVERAGE												
Existing condition	2010.0	0.0	1710.0	0.0	1321.0	0.0	1258.0	0.0	1020.0	0.0	791.0	0.0
Future conditions												
No project	1980.0	-29.0	1589.0	-121.0	1295.0	-26.0	1309.0	51.0	1115.0	95.0	916.0	125.0
LV - Old River	1980.0	-29.0	1589.0	-121.0	1294.0	-27.0	1306.0	48.0	1115.0	95.0	915.0	124.0
LV - Clifton Court	1980.0	-29.0	1588.0	-122.0	1293.0	-28.0	1306.0	47.0	1116.0	95.0	916.0	124.0
Middle River	1980.0	-29.0	1589.0	-121.0	1295.0	-26.0	1309.0	51.0	1115.0	95.0	916.0	125.0
Desalination	1980.0	-29.0	1589.0	-120.0	1295.0	-26.0	1310.0	52.0	1116.0	96.0	916.0	125.0
MAXIMUM												
Existing condition	6989.0	0.0	4957.0	0.0	3539.0	0.0	1619.0	0.0	1342.0	0.0	1318.0	0.0
Future conditions												
No project	7042.0	53.0	4631.0	-326.0	3396.0	-143.0	1494.0	-125.0	1431.0	89.0	1305.0	-13.0
LV - Old River	7042.0	53.0	4631.0	-326.0	3396.0	-143.0	1494.0	-125.0	1431.0	89.0	1305.0	-13.0
LV - Clifton Court	7042.0	53.0	4631.0	-326.0	3396.0	-143.0	1494.0	-125.0	1431.0	89.0	1305.0	-13.0
Middle River	7042.0	53.0	4631.0	-326.0	3396.0	-143.0	1494.0	-125.0	1431.0	89.0	1305.0	-13.0
Desalination	7042.0	53.0	4631.0	-326.0	3396.0	-143.0	1495.0	-124.0	1431.0	89.0	1305.0	-13.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES												
No project	50.9	46.0	31.6	11.0	68.4	14.0	86.0	17.0	82.5	117.0	73.7	185.5
LV - Old River	50.9	46.0	29.8	12.0	68.4	14.0	84.2	17.0	82.5	118.0	73.7	185.5
LV - Clifton Court	50.9	46.0	31.6	11.5	68.4	14.0	82.5	16.0	82.5	118.0	73.7	185.5
Middle River	50.9	46.0	31.6	11.0	68.4	14.0	86.0	17.0	82.5	117.0	73.7	185.5
Desalination	49.1	47.5	31.6	11.5	68.4	14.0	86.0	17.0	82.5	118.0	73.7	186.5
DECREASES												
No project	47.4	-56.0	68.4	-209.0	31.6	-111.5	12.3	-66.0	17.5	-93.0	26.3	-18.0
LV - Old River	47.4	-56.0	68.4	-209.0	31.6	-111.5	14.0	-38.5	17.5	-93.0	26.3	-19.0
LV - Clifton Court	47.4	-56.0	68.4	-209.0	31.6	-111.5	15.8	-11.0	17.5	-93.0	26.3	-18.0
Middle River	47.4	-56.0	68.4	-209.0	31.6	-111.5	12.3	-66.0	17.5	-93.0	26.3	-18.0
Desalination	49.1	-53.0	68.4	-208.0	31.6	-111.5	12.3	-64.0	15.8	-100.0	26.3	-17.0

Table 12. Monthly Flow Statistics for Delta Outflow under Future Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM																								
Existing condition	215.0	0.0	211.0	0.0	277.0	0.0	277.0	0.0	250.0	0.0	277.0	0.0	268.0	0.0	277.0	0.0	229.0	0.0	237.0	0.0	194.0	0.0	149.0	0.0
Future conditions																								
No project	215.0	0.0	208.0	-3.0	235.0	-42.0	277.0	0.0	250.0	0.0	277.0	0.0	268.0	0.0	277.0	0.0	229.0	0.0	237.0	0.0	194.0	0.0	151.0	2.0
LV - Old River	215.0	0.0	208.0	-3.0	236.0	-41.0	277.0	0.0	250.0	0.0	277.0	0.0	268.0	0.0	277.0	0.0	229.0	0.0	237.0	0.0	194.0	0.0	151.0	2.0
LV - Clifton Cour	215.0	0.0	208.0	-3.0	236.0	-41.0	277.0	0.0	250.0	0.0	277.0	0.0	268.0	0.0	277.0	0.0	229.0	0.0	237.0	0.0	194.0	0.0	151.0	2.0
Middle River	215.0	0.0	208.0	-3.0	235.0	-42.0	277.0	0.0	250.0	0.0	277.0	0.0	268.0	0.0	277.0	0.0	229.0	0.0	237.0	0.0	194.0	0.0	151.0	2.0
Desalination	215.0	0.0	208.0	-3.0	235.0	-42.0	277.0	0.0	250.0	0.0	277.0	0.0	268.0	0.0	277.0	0.0	229.0	0.0	237.0	0.0	194.0	0.0	150.0	1.0
MEDIAN																								
Existing condition	312.0	0.0	338.0	0.0	447.0	0.0	877.0	0.0	1379.0	0.0	1000.0	0.0	595.0	0.0	882.0	0.0	565.0	0.0	473.0	0.0	377.0	0.0	239.0	0.0
Future conditions																								
No project	277.0	-35.0	340.0	2.0	383.0	-64.0	844.0	-33.0	1356.0	-23.0	1053.0	53.0	595.0	0.0	663.0	-219.0	565.0	0.0	508.0	35.0	401.0	24.0	308.0	69.0
LV - Old River	277.0	-35.0	343.0	5.0	383.0	-64.0	832.0	-45.0	1356.0	-23.0	1053.0	53.0	595.0	0.0	663.0	-219.0	565.0	0.0	508.0	35.0	401.0	24.0	308.0	69.0
LV - Clifton Cour	277.0	-35.0	343.0	5.0	379.0	-68.0	832.0	-45.0	1356.0	-23.0	1053.0	53.0	595.0	0.0	663.0	-219.0	565.0	0.0	508.0	35.0	401.0	24.0	308.0	69.0
Middle River	277.0	-35.0	343.0	5.0	439.0	-8.0	738.0	-139.0	1356.0	-23.0	1053.0	53.0	595.0	0.0	663.0	-219.0	565.0	0.0	508.0	35.0	401.0	24.0	308.0	69.0
Desalination	277.0	-35.0	338.0	0.0	383.0	-64.0	843.0	-34.0	1356.0	-23.0	1052.0	52.0	595.0	0.0	663.0	-219.0	565.0	0.0	508.0	35.0	401.0	24.0	308.0	69.0
AVERAGE																								
Existing condition	442.0	0.0	589.0	0.0	1237.0	0.0	2110.0	0.0	2333.0	0.0	1904.0	0.0	1325.0	0.0	1199.0	0.0	743.0	0.0	468.0	0.0	355.0	0.0	251.0	0.0
Future conditions																								
No project	376.0	-67.0	463.0	-125.0	1056.0	-181.0	2002.0	-108.0	2228.0	-105.0	1886.0	-18.0	1323.0	-1.0	1073.0	-125.0	710.0	-33.0	478.0	10.0	386.0	32.0	284.0	33.0
LV - Old River	376.0	-67.0	463.0	-126.0	1057.0	-181.0	2002.0	-108.0	2229.0	-104.0	1885.0	-19.0	1321.0	-3.0	1072.0	-126.0	710.0	-34.0	478.0	10.0	386.0	32.0	285.0	34.0
LV - Clifton Cour	376.0	-67.0	462.0	-126.0	1058.0	-180.0	2002.0	-108.0	2229.0	-104.0	1884.0	-20.0	1321.0	-3.0	1073.0	-126.0	710.0	-34.0	478.0	10.0	386.0	32.0	284.0	34.0
Middle River	381.0	-62.0	471.0	-118.0	1061.0	-176.0	1963.0	-147.0	2233.0	-100.0	1901.0	-3.0	1282.0	-43.0	1087.0	-111.0	710.0	-33.0	476.0	8.0	387.0	32.0	285.0	34.0
Desalination	376.0	-67.0	463.0	-126.0	1054.0	-184.0	2001.0	-109.0	2226.0	-107.0	1885.0	-19.0	1323.0	-2.0	1073.0	-125.0	710.0	-34.0	478.0	10.0	386.0	32.0	284.0	33.0
MAXIMUM																								
Existing condition	1610.0	0.0	3588.0	0.0	5944.0	0.0	12226.0	0.0	8585.0	0.0	9519.0	0.0	6227.0	0.0	4435.0	0.0	2909.0	0.0	755.0	0.0	485.0	0.0	549.0	0.0
Future conditions																								
No project	1378.0	-232.0	2240.0	-1348	5149.0	-795.0	12031.0	-195.0	8332.0	-253.0	9425.0	-94.0	6334.0	107.0	4098.0	-337.0	2752.0	-157.0	615.0	-140.0	523.0	38.0	497.0	-52.0
LV - Old River	1378.0	-232.0	2253.0	-1335	5149.0	-795.0	12035.0	-191.0	8335.0	-250.0	9425.0	-94.0	6334.0	107.0	4097.0	-338.0	2751.0	-158.0	615.0	-140.0	523.0	38.0	497.0	-52.0
LV - Clifton Cour	1378.0	-232.0	2233.0	-1355	5149.0	-795.0	12032.0	-194.0	8335.0	-250.0	9425.0	-94.0	6333.0	106.0	4097.0	-338.0	2751.0	-158.0	615.0	-140.0	523.0	38.0	497.0	-52.0
Middle River	1378.0	-232.0	2240.0	-1348	5149.0	-795.0	12031.0	-195.0	8332.0	-253.0	9425.0	-94.0	6334.0	107.0	4098.0	-337.0	2752.0	-157.0	615.0	-140.0	523.0	38.0	497.0	-52.0
Desalination	1378.0	-232.0	2238.0	-1350	5148.0	-796.0	12029.0	-197.0	8330.0	-255.0	9425.0	-94.0	6333.0	106.0	4098.0	-337.0	2752.0	-157.0	615.0	-140.0	523.0	38.0	497.0	-52.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES																								
No project	1.8	62.0	17.5	20.5	21.1	25.0	19.3	48.0	19.3	16.0	40.4	77.0	29.8	81.0	0.0	0.0	5.3	1.0	36.8	37.0	78.9	42.0	73.7	54.0
LV - Old River	1.8	62.0	17.5	20.5	21.1	25.0	17.5	66.0	17.5	37.5	40.4	65.0	28.1	75.5	0.0	0.0	5.3	1.0	36.8	37.0	78.9	42.0	73.7	54.0
LV - Clifton Cour	1.8	62.0	17.5	20.5	21.1	24.0	17.5	63.0	17.5	39.0	40.4	65.0	28.1	75.5	0.0	0.0	5.3	1.0	36.8	37.0	78.9	42.0	73.7	54.0
Middle River	3.5	172.5	19.3	24.0	21.1	32.5	19.3	48.0	19.3	16.0	40.4	77.0	29.8	81.0	1.8	377.0	7.0	1.5	36.8	37.0	78.9	42.0	73.7	54.0
Desalination	1.8	62.0	17.5	20.5	22.8	19.0	19.3	47.0	19.3	16.0	38.6	80.5	29.8	81.0	0.0	0.0	5.3	1.0	36.8	37.0	78.9	42.0	73.7	54.0
DECREASES																								
No project	68.4	-64.0	70.2	-62.0	77.2	-87.5	80.7	-83.0	73.7	-73.5	47.4	-49.0	45.6	-30.0	63.2	-210.5	31.6	-110.5	21.1	-8.5	12.3	-41.0	26.3	-17.0
LV - Old River	68.4	-64.0	70.2	-63.0	77.2	-87.5	82.5	-81.0	75.4	-72.0	47.4	-50.0	47.4	-34.0	63.2	-210.5	31.6	-112.5	21.1	-8.5	12.3	-41.0	26.3	-17.0
LV - Clifton Cour	68.4	-64.0	70.2	-63.0	77.2	-87.5	80.7	-84.0	75.4	-72.0	47.4	-57.0	47.4	-34.0	63.2	-210.5	31.6	-112.5	21.1	-8.5	12.3	-41.0	26.3	-17.0
Middle River	68.4	-64.0	68.4	-63.0	77.2	-87.5	80.7	-83.0	73.7	-73.5	47.4	-49.0	45.6	-30.0	61.4	-202.0	31.6	-110.5	22.8	-9.0	12.3	-41.0	26.3	-17.0
Desalination	68.4	-64.0	70.2	-62.5	77.2	-87.5	80.7	-83.0	73.7	-74.5	47.4	-49.0	45.6	-30.0	63.2	-210.5	31.6	-111.0	21.1	-8.5	12.3	-41.0	26.3	-17.0

Table 13. Monthly Flow Statistics for the Delta Cross Channel under Future Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM												
Existing condition	178.2	0.0	307.1	0.0	348.0	0.0	262.1	0.0	225.0	0.0	265.4	0.0
Future conditions												
No project	210.7	32.5	289.5	-17.6	334.5	-13.5	255.3	-6.8	212.5	-12.5	241.0	-24.5
LV - Old River	210.8	32.6	289.5	-17.6	334.5	-13.5	255.3	-6.8	212.5	-12.5	240.9	-24.5
LV - Clifton Court	210.7	32.5	289.5	-17.6	334.5	-13.5	255.3	-6.8	212.5	-12.5	240.9	-24.6
Middle River	210.7	32.5	289.5	-17.6	334.6	-13.5	255.3	-6.8	212.5	-12.5	240.9	-24.5
Desalination	215.1	36.9	290.5	-16.6	335.4	-12.6	255.3	-6.8	212.5	-12.5	242.1	-23.4
MEDIAN												
Existing condition	407.9	0.0	462.4	0.0	478.9	0.0	444.3	0.0	417.4	0.0	437.1	0.0
Future conditions												
No project	368.0	-39.8	435.2	-27.3	472.7	-6.2	413.8	-30.5	391.7	-25.7	447.7	10.6
LV - Old River	368.0	-39.8	434.4	-28.0	473.5	-5.5	405.8	-38.6	391.6	-25.8	447.7	10.6
LV - Clifton Court	368.0	-39.8	435.2	-27.3	472.8	-6.1	405.8	-38.6	392.3	-25.1	447.6	10.6
Middle River	368.1	-39.8	435.2	-27.3	472.7	-6.3	413.8	-30.6	391.7	-25.7	447.7	10.6
Desalination	368.4	-39.4	435.5	-26.9	470.4	-8.5	413.8	-30.6	391.5	-25.9	447.7	10.6
AVERAGE												
Existing condition	419.9	0.0	473.5	0.0	494.2	0.0	472.9	0.0	434.0	0.0	458.8	0.0
Future conditions												
No project	385.3	-34.6	440.6	-32.8	482.7	-11.5	460.2	-12.7	422.5	-11.5	457.6	-1.2
LV - Old River	384.3	-35.6	440.5	-33.0	483.3	-11.0	455.5	-17.4	422.9	-11.1	457.6	-1.2
LV - Clifton Court	384.5	-35.4	440.6	-32.9	483.6	-10.6	455.6	-17.3	422.8	-11.1	457.6	-1.2
Middle River	385.3	-34.6	440.7	-32.8	482.7	-11.5	460.2	-12.7	422.5	-11.5	457.6	-1.2
Desalination	385.9	-33.9	440.9	-32.6	482.4	-11.8	460.3	-12.6	422.2	-11.8	457.6	-1.2
MAXIMUM												
Existing condition	670.1	0.0	654.9	0.0	741.4	0.0	948.0	0.0	831.5	0.0	948.5	0.0
Future conditions												
No project	614.6	-55.5	592.7	-62.2	673.7	-67.7	941.9	-6.1	735.5	-96.0	925.8	-22.8
LV - Old River	614.6	-55.5	592.7	-62.2	673.7	-67.7	941.9	-6.1	735.5	-96.0	925.8	-22.8
LV - Clifton Court	614.6	-55.5	592.7	-62.2	673.7	-67.7	941.9	-6.1	735.5	-96.0	925.8	-22.8
Middle River	614.6	-55.5	592.7	-62.2	673.7	-67.7	941.9	-6.1	735.5	-96.0	925.8	-22.8
Desalination	614.6	-55.5	592.7	-62.2	673.7	-67.7	941.9	-6.1	735.5	-96.0	925.8	-22.8
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES												
No project	15.8	9.3	26.3	4.6	38.6	25.2	33.3	23.0	43.9	11.0	52.6	10.1
LV - Old River	14.0	17.6	22.8	4.6	38.6	25.4	33.3	18.1	47.4	8.1	52.6	10.1
LV - Clifton Court	14.0	17.6	26.3	4.6	38.6	25.2	33.3	18.1	47.4	8.1	52.6	10.1
Middle River	15.8	9.3	26.3	4.6	38.6	25.2	33.3	23.0	43.9	11.0	52.6	10.1
Desalination	19.3	8.7	26.3	5.2	38.6	20.6	33.3	23.0	43.9	11.0	52.6	10.1
DECREASES												
No project	84.2	-42.3	73.7	-31.6	61.4	-38.4	66.7	-39.7	52.6	-22.8	47.4	-9.3
LV - Old River	86.0	-39.1	77.2	-30.7	61.4	-38.4	66.7	-39.7	52.6	-22.7	47.4	-9.3
LV - Clifton Court	86.0	-39.1	73.7	-31.6	61.4	-38.4	66.7	-39.7	52.6	-22.7	47.4	-9.3
Middle River	84.2	-42.3	73.7	-31.6	61.4	-38.4	66.7	-39.7	52.6	-22.8	47.4	-9.3
Desalination	80.7	-46.4	73.7	-31.1	61.4	-38.5	66.7	-39.5	56.1	-18.5	47.4	-9.3

	APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM												
Existing condition	246.7	0.0	313.5	0.0	298.5	0.0	322.4	0.0	249.7	0.0	213.1	0.0
Future conditions												
No project	249.4	2.7	303.2	-10.3	286.9	-11.7	311.7	-10.8	261.3	11.6	247.5	34.4
LV - Old River	249.4	2.7	303.2	-10.3	286.9	-11.7	311.8	-10.6	261.4	11.7	247.6	34.5
LV - Clifton Court	249.4	2.7	303.2	-10.3	286.9	-11.7	311.8	-10.6	261.3	11.6	247.6	34.5
Middle River	249.4	2.7	303.2	-10.3	286.9	-11.7	311.7	-10.7	261.4	11.7	247.5	34.4
Desalination	250.0	3.3	303.2	-10.3	288.5	-10.1	312.7	-9.7	261.3	11.6	247.6	34.5
MEDIAN												
Existing condition	460.3	0.0	446.9	0.0	446.2	0.0	554.7	0.0	464.9	0.0	355.0	0.0
Future conditions												
No project	445.0	-15.3	435.0	-11.9	448.0	1.8	561.1	6.3	505.4	40.6	429.3	74.3
LV - Old River	445.0	-15.3	435.0	-11.9	448.0	1.8	561.1	6.3	505.4	40.6	429.3	74.3
LV - Clifton Court	445.1	-15.2	435.0	-11.9	448.0	1.8	559.1	4.3	505.4	40.6	429.3	74.3
Middle River	445.0	-15.3	435.0	-11.9	448.0	1.8	561.1	6.3	505.4	40.6	429.3	74.3
Desalination	445.0	-15.3	435.4	-11.5	448.0	1.8	561.3	6.6	506.1	41.2	429.3	74.3
AVERAGE												
Existing condition	438.6	0.0	477.1	0.0	457.9	0.0	529.0	0.0	454.4	0.0	353.8	0.0
Future conditions												
No project	428.8	-9.8	462.5	-14.6	454.4	-3.5	544.8	15.8	488.0	33.6	402.5	48.7
LV - Old River	428.8	-9.8	462.4	-14.7	453.9	-3.9	544.0	15.0	488.0	33.6	402.3	48.5
LV - Clifton Court	428.8	-9.8	462.0	-15.1	453.6	-4.3	543.7	14.7	488.1	33.7	402.4	48.6
Middle River	428.8	-9.8	462.5	-14.5	454.4	-3.5	544.8	15.8	488.0	33.6	402.5	48.7
Desalination	428.8	-9.8	462.7	-14.4	454.6	-3.3	545.0	16.1	488.4	34.0	402.6	48.8
MAXIMUM												
Existing condition	735.7	0.0	720.6	0.0	624.3	0.0	619.7	0.0	571.5	0.0	506.6	0.0
Future conditions												
No project	732.8	-2.9	685.2	-35.4	584.0	-40.2	613.6	-6.1	601.8	30.4	496.2	-10.4
LV - Old River	732.9	-2.8	685.2	-35.4	584.0	-40.2	613.6	-6.1	601.8	30.4	496.3	-10.4
LV - Clifton Court	732.9	-2.8	685.2	-35.4	584.0	-40.2	613.6	-6.1	601.9	30.4	496.3	-10.4
Middle River	732.8	-2.9	685.2	-35.4	584.1	-40.2	613.6	-6.1	601.8	30.4	496.3	-10.4
Desalination	732.8	-2.9	685.2	-35.4	584.0	-40.2	613.6	-6.1	602.2	30.7	496.6	-10.1
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES												
No project	54.4	8.8	14.0	9.8	45.6	4.6	61.4	19.2	82.5	40.5	77.2	64.8
LV - Old River	54.4	8.9	14.0	9.5	43.9	5.1	59.6	20.8	82.5	40.5	77.2	64.8
LV - Clifton Court	54.4	8.9	12.3	7.9	42.1	4.0	59.6	20.0	82.5	40.5	77.2	64.8
Middle River	54.4	8.9	14.0	9.8	45.6	4.6	61.4	19.2	82.5	40.5	77.2	64.9
Desalination	54.4	8.9	14.0	10.5	45.6	4.8	61.4	19.2	82.5	40.8	77.2	64.8
DECREASES												
No project	45.6	-32.6	86.0	-25.5	54.4	-11.1	38.6	-6.4	17.5	-34.6	21.1	-8.7
LV - Old River	45.6	-32.6	86.0	-25.5	56.1	-9.6	40.4	-6.1	17.5	-35.3	21.1	-9.3
LV - Clifton Court	45.6	-32.6	87.7	-23.3	57.9	-11.0	40.4	-6.2	17.5	-34.8	21.1	-9.1
Middle River	45.6	-32.6	86.0	-25.5	54.4	-11.1	38.6	-6.3	17.5	-34.5	21.1	-8.7
Desalination	45.6	-32.2	86.0	-25.1	54.4	-10.1	38.6	-6.2	17.5	-34.1	22.8	-6.7

Table 14. Monthly Storage Statistics for Shasta Reservoir under Future Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF
MINIMUM																								
Existing condition	779.0	0.0	720.0	0.0	975.0	0.0	1086.0	0.0	1197.0	0.0	1658.0	0.0	1611.0	0.0	1561.0	0.0	1336.0	0.0	968.0	0.0	816.0	0.0	825.0	0.0
Future conditions																								
No project	393.0	-386.0	373.0	-347.0	383.0	-592.0	490.0	-596.0	573.0	-624.0	884.0	-774.0	997.0	-614.0	1022.0	-539.0	887.0	-449.0	637.0	-331.0	426.0	-390.0	349.0	-476.0
LV - Old River	409.0	-370.0	398.0	-322.0	404.0	-571.0	504.0	-582.0	586.0	-611.0	914.0	-744.0	1029.0	-582.0	1052.0	-509.0	914.0	-422.0	660.0	-308.0	452.0	-364.0	366.0	-459.0
LV - Clifton Court	409.0	-370.0	398.0	-322.0	403.0	-572.0	504.0	-582.0	586.0	-611.0	913.0	-745.0	1027.0	-584.0	1051.0	-510.0	913.0	-423.0	660.0	-308.0	453.0	-363.0	366.0	-459.0
Middle River	393.0	-386.0	373.0	-347.0	383.0	-592.0	490.0	-596.0	573.0	-624.0	884.0	-774.0	997.0	-614.0	1022.0	-539.0	887.0	-449.0	637.0	-331.0	426.0	-390.0	349.0	-476.0
Desalination	370.0	-409.0	340.0	-380.0	364.0	-611.0	476.0	-610.0	560.0	-637.0	856.0	-802.0	965.0	-646.0	991.0	-570.0	857.0	-479.0	610.0	-358.0	402.0	-414.0	334.0	-491.0
MEDIAN																								
Existing condition	2838.0	0.0	2934.0	0.0	3293.0	0.0	3346.0	0.0	3588.0	0.0	3940.0	0.0	4289.0	0.0	4405.0	0.0	3949.0	0.0	3315.0	0.0	2909.0	0.0	2856.0	0.0
Future conditions																								
No project	2684.0	-154.0	2741.0	-193.0	3252.0	-41.0	3317.0	-29.0	3522.0	-66.0	3933.0	-7.0	4195.0	-94.0	4303.0	-102.0	3902.0	-47.0	3267.0	-48.0	2705.0	-204.0	2654.0	-202.0
LV - Old River	2689.0	-149.0	2741.0	-193.0	3252.0	-41.0	3317.0	-29.0	3522.0	-66.0	3933.0	-7.0	4210.0	-79.0	4303.0	-102.0	3902.0	-47.0	3284.0	-31.0	2709.0	-200.0	2663.0	-193.0
LV - Clifton Court	2703.0	-135.0	2762.0	-172.0	3252.0	-41.0	3317.0	-29.0	3522.0	-66.0	3933.0	-7.0	4236.0	-53.0	4309.0	-96.0	3903.0	-46.0	3267.0	-48.0	2707.0	-202.0	2676.0	-180.0
Middle River	2684.0	-154.0	2741.0	-193.0	3252.0	-41.0	3317.0	-29.0	3522.0	-66.0	3933.0	-7.0	4195.0	-94.0	4303.0	-102.0	3902.0	-47.0	3267.0	-48.0	2705.0	-204.0	2654.0	-202.0
Desalination	2681.0	-157.0	2737.0	-197.0	3252.0	-41.0	3317.0	-29.0	3521.0	-67.0	3932.0	-8.0	4187.0	-102.0	4302.0	-103.0	3901.0	-48.0	3266.0	-49.0	2703.0	-206.0	2652.0	-204.0
AVERAGE																								
Existing condition	2686.3	0.0	2681.2	0.0	2832.2	0.0	3060.7	0.0	3380.6	0.0	3671.3	0.0	3973.2	0.0	3991.4	0.0	3727.7	0.0	3198.8	0.0	2809.6	0.0	2746.8	0.0
Future conditions																								
No project	2512.4	-173.9	2511.0	-170.2	2693.3	-138.9	2933.2	-127.5	3267.2	-113.4	3564.7	-106.6	3874.5	-98.8	3895.8	-95.7	3626.9	-100.8	3109.3	-89.5	2671.3	-138.3	2574.8	-172.0
LV - Old River	2523.9	-162.4	2522.7	-158.5	2702.9	-129.4	2942.3	-118.5	3274.4	-106.2	3571.7	-99.6	3881.4	-91.8	3903.0	-88.4	3634.8	-92.9	3118.7	-80.1	2680.7	-128.9	2584.8	-162.0
LV - Clifton Court	2525.9	-160.4	2524.8	-156.5	2703.6	-128.6	2942.8	-118.0	3275.1	-105.4	3572.6	-98.8	3882.2	-91.0	3904.3	-87.1	3636.8	-90.9	3121.4	-77.4	2683.3	-126.4	2587.2	-159.6
Middle River	2512.4	-173.9	2511.0	-170.2	2693.3	-138.9	2933.2	-127.5	3267.2	-113.4	3564.7	-106.6	3874.5	-98.8	3895.8	-95.7	3626.9	-100.8	3109.3	-89.5	2671.3	-138.3	2574.8	-172.0
Desalination	2503.0	-183.3	2501.1	-180.1	2684.9	-147.3	2924.9	-135.9	3260.0	-120.6	3557.3	-114.0	3866.8	-106.4	3888.0	-103.5	3618.7	-109.0	3101.2	-97.7	2663.7	-145.9	2566.6	-180.2
MAXIMUM																								
Existing condition	3400.0	0.0	3252.0	0.0	3380.0	0.0	3725.0	0.0	4552.0	0.0	4318.0	0.0	4552.0	0.0	4552.0	0.0	4552.0	0.0	4300.0	0.0	4000.0	0.0	3700.0	0.0
Future conditions																								
No project	3400.0	0.0	3252.0	0.0	3380.0	0.0	3725.0	0.0	4552.0	0.0	4323.0	5.0	4552.0	0.0	4552.0	0.0	4552.0	0.0	4300.0	0.0	4000.0	0.0	3700.0	0.0
LV - Old River	3400.0	0.0	3252.0	0.0	3380.0	0.0	3725.0	0.0	4552.0	0.0	4323.0	5.0	4552.0	0.0	4552.0	0.0	4552.0	0.0	4300.0	0.0	4000.0	0.0	3700.0	0.0
LV - Clifton Court	3400.0	0.0	3252.0	0.0	3380.0	0.0	3725.0	0.0	4552.0	0.0	4323.0	5.0	4552.0	0.0	4552.0	0.0	4552.0	0.0	4300.0	0.0	4000.0	0.0	3700.0	0.0
Middle River	3400.0	0.0	3252.0	0.0	3380.0	0.0	3725.0	0.0	4552.0	0.0	4323.0	5.0	4552.0	0.0	4552.0	0.0	4552.0	0.0	4300.0	0.0	4000.0	0.0	3700.0	0.0
Desalination	3400.0	0.0	3252.0	0.0	3380.0	0.0	3725.0	0.0	4552.0	0.0	4322.0	4.0	4552.0	0.0	4552.0	0.0	4552.0	0.0	4300.0	0.0	4000.0	0.0	3700.0	0.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES																								
No project	12.3	86.0	8.8	118.0	12.3	37.0	14.0	40.5	15.8	29.0	19.3	29.0	28.1	36.5	21.1	47.5	26.3	31.0	43.9	56.0	35.1	43.5	19.3	46.0
LV - Old River	12.3	131.0	8.8	160.0	12.3	37.0	14.0	56.5	17.5	27.5	21.1	27.5	28.1	37.5	21.1	47.5	26.3	47.0	45.6	56.5	35.1	43.5	19.3	46.0
LV - Clifton Court	12.3	130.0	8.8	160.0	12.3	37.0	14.0	56.0	17.5	28.0	21.1	27.5	28.1	36.5	22.8	46.0	26.3	47.0	45.6	58.5	35.1	47.0	19.3	46.0
Middle River	12.3	86.0	8.8	118.0	12.3	37.0	14.0	40.5	15.8	29.0	19.3	29.0	28.1	36.5	21.1	47.5	26.3	31.0	43.9	56.0	35.1	43.5	19.3	46.0
Desalination	12.3	72.0	8.8	83.0	10.5	51.5	14.0	35.5	14.0	37.0	17.5	31.0	26.3	39.0	21.1	43.0	26.3	29.0	43.9	56.0	33.3	44.0	19.3	45.0
DECREASES																								
No project	66.7	-218.5	61.4	-221.0	43.9	-256.0	42.1	-248.0	35.1	-234.5	35.1	-169.5	38.6	-116.5	42.1	-86.5	54.4	-113.0	54.4	-135.0	63.2	-168.5	71.9	-188.0
LV - Old River	66.7	-208.5	61.4	-212.0	43.9	-239.0	40.4	-239.0	33.3	-230.0	33.3	-165.0	38.6	-114.0	42.1	-76.0	54.4	-97.0	52.6	-128.0	63.2	-160.0	70.2	-162.0
LV - Clifton Court	66.7	-209.0	61.4	-212.0	43.9	-249.0	40.4	-252.0	33.3	-230.0	33.3	-167.0	38.6	-102.5	40.4	-77.0	54.4	-92.0	52.6	-130.5	63.2	-160.5	71.9	-146.0
Middle River	66.7	-218.5	61.4	-221.0	43.9	-256.0	42.1	-248.0	35.1	-234.5	35.1	-169.5	38.6	-116.5	42.1	-86.5	54.4	-113.0	54.4	-135.0	63.2	-168.5	71.9	-188.0
Desalination	66.7	-226.0	61.4	-232.0	45.6	-263.5	42.1	-256.0	36.8	-236.0	35.1	-184.0	38.6	-122.5	42.1	-95.0	54.4	-118.0	54.4	-144.0	64.9	-166.0	73.7	-176.0

Table 15. Monthly Storage Statistics for Folsom Reservoir under Future Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF
MINIMUM																								
Existing condition	69.0	0.0	61.0	0.0	152.0	0.0	203.0	0.0	194.0	0.0	193.0	0.0	195.0	0.0	199.0	0.0	177.0	0.0	131.0	0.0	107.0	0.0	82.0	0.0
Future conditions																								
No project	5.0	-64.0	1.0	-60.0	67.0	-85.0	123.0	-80.0	148.0	-46.0	173.0	-20.0	170.0	-25.0	170.0	-29.0	137.0	-40.0	85.0	-46.0	41.0	-66.0	17.0	-65.0
LV - Old River	9.0	-60.0	1.0	-60.0	68.0	-84.0	125.0	-78.0	151.0	-43.0	178.0	-15.0	175.0	-20.0	175.0	-24.0	141.0	-36.0	89.0	-42.0	45.0	-62.0	21.0	-61.0
LV - Clifton Court	9.0	-60.0	1.0	-60.0	68.0	-84.0	125.0	-78.0	151.0	-43.0	178.0	-15.0	175.0	-20.0	175.0	-24.0	141.0	-36.0	89.0	-42.0	45.0	-62.0	21.0	-61.0
Middle River	5.0	-64.0	1.0	-60.0	67.0	-85.0	123.0	-80.0	148.0	-46.0	173.0	-20.0	170.0	-25.0	170.0	-29.0	137.0	-40.0	85.0	-46.0	41.0	-66.0	17.0	-65.0
Desalination	3.0	-66.0	1.0	-60.0	65.0	-87.0	122.0	-81.0	145.0	-49.0	171.0	-22.0	168.0	-27.0	168.0	-31.0	134.0	-43.0	83.0	-48.0	39.0	-68.0	15.0	-67.0
MEDIAN																								
Existing condition	556.0	0.0	549.0	0.0	610.0	0.0	619.0	0.0	686.0	0.0	794.0	0.0	969.0	0.0	1010.0	0.0	961.0	0.0	793.0	0.0	639.0	0.0	594.0	0.0
Future conditions																								
No project	418.0	-138.0	440.0	-109.0	569.0	-41.0	610.0	-9.0	634.0	-52.0	700.0	-94.0	835.0	-134.0	984.0	-26.0	886.0	-75.0	662.0	-131.0	524.0	-115.0	439.0	-155.0
LV - Old River	419.0	-137.0	440.0	-109.0	570.0	-40.0	610.0	-9.0	633.0	-53.0	700.0	-94.0	835.0	-134.0	984.0	-26.0	886.0	-75.0	665.0	-128.0	524.0	-115.0	439.0	-155.0
LV - Clifton Court	419.0	-137.0	441.0	-108.0	569.0	-41.0	610.0	-9.0	633.0	-53.0	700.0	-94.0	835.0	-134.0	984.0	-26.0	886.0	-75.0	662.0	-131.0	524.0	-115.0	439.0	-155.0
Middle River	418.0	-138.0	440.0	-109.0	569.0	-41.0	610.0	-9.0	634.0	-52.0	700.0	-94.0	835.0	-134.0	984.0	-26.0	886.0	-75.0	662.0	-131.0	524.0	-115.0	439.0	-155.0
Desalination	418.0	-138.0	439.0	-110.0	568.0	-42.0	610.0	-9.0	633.0	-53.0	700.0	-94.0	835.0	-134.0	984.0	-26.0	886.0	-75.0	657.0	-136.0	523.0	-116.0	439.0	-155.0
AVERAGE																								
Existing condition	514.3	0.0	494.2	0.0	512.0	0.0	576.4	0.0	646.9	0.0	735.1	0.0	889.7	0.0	919.0	0.0	874.2	0.0	727.7	0.0	611.9	0.0	562.7	0.0
Future conditions																								
No project	417.8	-96.5	422.3	-71.9	470.2	-41.8	524.1	-52.3	591.3	-55.6	656.0	-79.1	767.1	-122.6	880.8	-38.2	825.3	-48.9	657.9	-69.8	516.9	-95.0	447.5	-115.1
LV - Old River	419.7	-94.6	423.7	-70.5	471.4	-40.6	524.9	-51.5	591.9	-55.0	656.8	-78.2	768.1	-121.6	881.5	-37.5	826.4	-47.8	660.0	-67.8	518.9	-93.1	448.9	-113.7
LV - Clifton Court	420.1	-94.2	424.0	-70.3	471.6	-40.4	525.1	-51.4	591.9	-55.0	656.9	-78.1	768.1	-121.5	881.7	-37.3	826.7	-47.5	660.4	-67.3	519.4	-92.5	449.3	-113.4
Middle River	417.8	-96.5	422.3	-71.9	470.2	-41.8	524.1	-52.3	591.3	-55.6	656.0	-79.1	767.1	-122.6	880.8	-38.2	825.3	-48.9	657.9	-69.8	516.9	-95.0	447.5	-115.1
Desalination	415.6	-98.6	420.9	-73.4	469.1	-42.9	523.1	-53.3	590.4	-56.4	655.2	-79.9	766.7	-123.0	880.2	-38.7	824.4	-49.8	656.1	-71.6	514.2	-97.8	445.4	-117.3
MAXIMUM																								
Existing condition	680.0	0.0	610.0	0.0	610.0	0.0	687.0	0.0	758.0	0.0	860.0	0.0	1010.0	0.0	1010.0	0.0	1010.0	0.0	960.0	0.0	860.0	0.0	780.0	0.0
Future conditions																								
No project	755.0	75.0	610.0	0.0	610.0	0.0	610.0	-77.0	660.0	-98.0	735.0	-125.0	835.0	-175.0	1010.0	0.0	1010.0	0.0	1010.0	50.0	930.0	70.0	872.0	92.0
LV - Old River	755.0	75.0	610.0	0.0	610.0	0.0	610.0	-77.0	660.0	-98.0	735.0	-125.0	835.0	-175.0	1010.0	0.0	1010.0	0.0	1010.0	50.0	930.0	70.0	872.0	92.0
LV - Clifton Court	755.0	75.0	610.0	0.0	610.0	0.0	610.0	-77.0	660.0	-98.0	735.0	-125.0	835.0	-175.0	1010.0	0.0	1010.0	0.0	1010.0	50.0	930.0	70.0	872.0	92.0
Middle River	755.0	75.0	610.0	0.0	610.0	0.0	610.0	-77.0	660.0	-98.0	735.0	-125.0	835.0	-175.0	1010.0	0.0	1010.0	0.0	1010.0	50.0	930.0	70.0	872.0	92.0
Desalination	755.0	75.0	610.0	0.0	610.0	0.0	610.0	-77.0	660.0	-98.0	735.0	-125.0	835.0	-175.0	1010.0	0.0	1010.0	0.0	1010.0	50.0	930.0	70.0	872.0	92.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES																								
No project	10.5	55.0	3.5	46.0	7.0	16.5	7.0	18.5	7.0	32.0	8.8	38.0	3.5	127.5	7.0	48.0	8.8	123.0	14.0	49.5	10.5	52.5	7.0	72.5
LV - Old River	10.5	63.5	3.5	57.0	8.8	5.0	10.5	5.0	8.8	22.0	8.8	41.0	3.5	129.5	7.0	51.5	8.8	126.0	14.0	50.5	8.8	61.0	7.0	79.5
LV - Clifton Court	10.5	63.5	3.5	56.0	8.8	5.0	10.5	5.0	8.8	20.0	8.8	40.0	3.5	129.5	7.0	51.5	8.8	126.0	14.0	50.5	8.8	61.0	7.0	78.5
Middle River	10.5	55.0	3.5	46.0	7.0	16.5	7.0	18.5	7.0	32.0	8.8	38.0	3.5	127.5	7.0	48.0	8.8	123.0	14.0	49.5	10.5	52.5	7.0	72.5
Desalination	10.5	50.0	3.5	41.0	7.0	14.0	7.0	16.0	7.0	30.0	8.8	35.0	3.5	123.5	7.0	44.0	8.8	119.0	14.0	49.5	8.8	61.0	7.0	68.5
DECREASES																								
No project	89.5	-105.0	80.7	-70.5	50.9	-75.0	78.9	-61.0	86.0	-78.0	91.2	-90.5	94.7	-151.5	54.4	-91.0	66.7	-71.0	86.0	-79.0	89.5	-102.0	93.0	-121.0
LV - Old River	89.5	-105.0	78.9	-70.0	50.9	-75.0	77.2	-64.5	84.2	-79.0	91.2	-92.0	93.0	-152.0	54.4	-91.0	66.7	-71.0	86.0	-78.0	91.2	-101.0	93.0	-121.0
LV - Clifton Court	89.5	-104.0	78.9	-69.0	50.9	-74.0	77.2	-63.0	84.2	-79.0	91.2	-92.0	93.0	-153.0	54.4	-91.0	66.7	-71.0	86.0	-77.0	91.2	-100.0	93.0	-120.0
Middle River	89.5	-105.0	80.7	-70.5	50.9	-75.0	78.9	-61.0	86.0	-78.0	91.2	-90.5	94.7	-151.5	54.4	-91.0	66.7	-71.0	86.0	-79.0	89.5	-102.0	93.0	-121.0
Desalination	89.5	-106.0	80.7	-71.0	52.6	-73.5	80.7	-59.0	86.0	-78.0	91.2	-95.0	94.7	-151.5	54.4	-91.0	66.7	-71.0	86.0	-79.0	91.2	-101.5	93.0	-121.0

Table 16. Monthly Storage Statistics for Clair Engle Reservoir under Future Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF
MINIMUM																								
Existing condition	305.0	0.0	302.0	0.0	313.0	0.0	305.0	0.0	309.0	0.0	391.0	0.0	527.0	0.0	628.0	0.0	694.0	0.0	514.0	0.0	342.0	0.0	313.0	0.0
Future conditions																								
No project	133.0	-172.0	87.0	-215.0	95.0	-218.0	164.0	-141.0	211.0	-98.0	317.0	-74.0	403.0	-124.0	447.0	-181.0	378.0	-316.0	313.0	-201.0	276.0	-66.0	190.0	-123.0
LV - Old River	157.0	-148.0	112.0	-190.0	125.0	-188.0	194.0	-111.0	243.0	-66.0	332.0	-59.0	415.0	-112.0	471.0	-157.0	395.0	-299.0	313.0	-201.0	291.0	-51.0	214.0	-99.0
LV - Clifton Cour	158.0	-147.0	113.0	-189.0	126.0	-187.0	194.0	-111.0	243.0	-66.0	332.0	-59.0	415.0	-112.0	471.0	-157.0	396.0	-298.0	313.0	-201.0	291.0	-51.0	214.0	-99.0
Middle River	133.0	-172.0	87.0	-215.0	95.0	-218.0	164.0	-141.0	211.0	-98.0	317.0	-74.0	403.0	-124.0	447.0	-181.0	378.0	-316.0	313.0	-201.0	276.0	-66.0	190.0	-123.0
Desalination	111.0	-194.0	64.0	-238.0	69.0	-244.0	137.0	-168.0	181.0	-128.0	308.0	-83.0	394.0	-133.0	425.0	-203.0	363.0	-331.0	313.0	-201.0	259.0	-83.0	168.0	-145.0
MEDIAN																								
Existing condition	1619.0	0.0	1600.0	0.0	1668.0	0.0	1759.0	0.0	1797.0	0.0	1890.0	0.0	1989.0	0.0	2129.0	0.0	2098.0	0.0	1927.0	0.0	1758.0	0.0	1681.0	0.0
Future conditions																								
No project	1600.0	-19.0	1575.0	-25.0	1667.0	-1.0	1756.0	-3.0	1791.0	-6.0	1890.0	0.0	1979.0	-10.0	2093.0	-36.0	2089.0	-9.0	1884.0	-43.0	1716.0	-42.0	1618.0	-63.0
LV - Old River	[illegible]	19.0	1575.0	-25.0	1668.0	0.0	1756.0	-3.0	1791.0	-6.0	1890.0	0.0	1981.0	-8.0	2097.0	-32.0	2089.0	-9.0	1887.0	-40.0	1719.0	-39.0	1632.0	-49.0
LV - Clifton Cour	[illegible]	19.0	1577.0	-23.0	1669.0	1.0	1756.0	-3.0	1794.0	-3.0	1890.0	0.0	1981.0	-8.0	2095.0	-34.0	2091.0	-7.0	1888.0	-39.0	1722.0	-36.0	1632.0	-49.0
Middle River	1600.0	-19.0	1575.0	-25.0	1667.0	-1.0	1756.0	-3.0	1791.0	-6.0	1890.0	0.0	1979.0	-10.0	2093.0	-36.0	2089.0	-9.0	1884.0	-43.0	1716.0	-42.0	1618.0	-63.0
Desalination	1600.0	-19.0	1575.0	-25.0	1667.0	-1.0	1747.0	-12.0	1791.0	-6.0	1890.0	0.0	1976.0	-13.0	2090.0	-39.0	2087.0	-11.0	1882.0	-45.0	1714.0	-44.0	1611.0	-70.0
AVERAGE																								
Existing condition	1462.5	0.0	1465.0	0.0	1483.4	0.0	1563.1	0.0	1651.8	0.0	1765.1	0.0	1897.9	0.0	1989.4	0.0	1987.1	0.0	1820.5	0.0	1642.5	0.0	1538.4	0.0
Future conditions																								
No project	1442.1	-20.4	1443.5	-21.6	1461.8	-21.5	1542.3	-20.8	1631.5	-20.3	1744.8	-20.3	1877.6	-20.3	1967.4	-22.0	1962.7	-24.4	1798.2	-22.3	1624.2	-18.3	1519.1	-19.4
LV - Old River	1445.5	-17.0	1447.6	-17.4	1466.4	-16.9	1546.7	-16.4	1635.9	-15.9	1748.8	-16.3	1881.6	-16.3	1971.5	-17.9	1966.8	-20.3	1801.9	-18.5	1628.0	-14.5	1523.1	-15.4
LV - Clifton Cour	1446.0	-16.5	1448.0	-17.0	1466.6	-16.7	1547.0	-16.1	1636.0	-15.8	1748.9	-16.1	1881.8	-16.2	1971.7	-17.6	1967.1	-19.9	1802.2	-18.2	1628.3	-14.2	1523.4	-15.1
Middle River	1442.1	-20.4	1443.5	-21.6	1461.8	-21.5	1542.3	-20.8	1631.5	-20.3	1744.8	-20.3	1877.6	-20.3	1967.4	-22.0	1962.7	-24.4	1798.2	-22.3	1624.2	-18.3	1519.1	-19.4
Desalination	1438.5	-24.0	1439.5	-25.6	1457.3	-26.1	1537.6	-25.5	1627.2	-24.6	1740.9	-24.2	1873.8	-24.1	1963.6	-25.8	1958.9	-28.2	1794.8	-25.7	1620.7	-21.8	1515.2	-23.2
MAXIMUM																								
Existing condition	2040.0	0.0	2094.0	0.0	2189.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2400.0	0.0	2239.0	0.0	2133.0	0.0
Future conditions																								
No project	2048.0	8.0	2067.0	-27.0	2163.0	-26.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2401.0	1.0	2243.0	4.0	2141.0	8.0
LV - Old River	2048.0	8.0	2069.0	-25.0	2164.0	-25.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2401.0	1.0	2243.0	4.0	2141.0	8.0
LV - Clifton Cour	2048.0	8.0	2067.0	-27.0	2163.0	-26.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2401.0	1.0	2243.0	4.0	2141.0	8.0
Middle River	2048.0	8.0	2067.0	-27.0	2163.0	-26.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0 0	2448.0	0.0	2401.0	1.0	2243.0	4.0	2141.0	8.0
Desalination	2048.0	8.0	2067.0	-27.0	2163.0	-26.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2448.0	0.0	2401.0	1.0	2243.0	4.0	2141.0	8.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES																								
No project	24.6	3.5	21.1	4.0	10.5	3.0	14.0	3.0	12.3	3.0	17.5	2.5	24.6	2.5	19.3	3.0	17.5	3.0	28.1	3.0	28.1	3.5	26.3	4.0
LV - Old River	26.3	4.0	22.8	5.0	10.5	4.5	15.8	3.0	14.0	3.5	19.3	2.0	24.6	2.5	19.3	3.0	17.5	3.0	28.1	3.0	28.1	3.5	26.3	4.0
LV - Clifton Cour	26.3	4.0	24.6	4.5	10.5	5.0	15.8	4.0	14.0	4.0	19.3	3.0	24.6	3.0	21.1	3.0	19.3	3.0	29.8	3.0	29.8	4.0	26.3	4.0
Middle River	24.6	3.5	21.1	4.0	10.5	3.0	14.0	3.0	12.3	3.0	17.5	2.5	24.6	2.5	19.3	3.0	17.5	3.0	28.1	3.0	28.1	3.5	26.3	4.0
Desalination	22.8	4.0	19.3	3.0	7.0	3.0	8.8	3.0	7.0	2.5	14.0	2.0	21.1	2.0	15.8	2.0	15.8	3.0	26.3	2.0	24.6	3.0	24.6	4.0
DECREASES																								
No project	68.4	-18.0	64.9	-23.0	54.4	-26.0	56.1	-24.0	52.6	-25.0	52.6	-25.0	54.4	-24.0	49.1	-24.5	63.2	-19.5	63.2	-17.5	66.7	-19.5	68.4	-22.0
LV - Old River	66.7	-16.0	63.2	-21.0	54.4	-21.0	54.4	-20.0	50.9	-22.0	50.9	-22.0	54.4	-20.0	49.1	-21.0	61.4	-16.0	61.4	-16.0	66.7	-18.5	68.4	-19.0
LV - Clifton Cour	64.9	-15.0	61.4	-20.0	52.6	-22.0	52.6	-21.0	49.1	-22.5	49.1	-22.5	49.1	-21.0	49.1	-20.5	59.6	-15.0	61.4	-15.0	64.9	-20.0	66.7	-19.5
Middle River	68.4	-18.0	64.9	-23.0	54.4	-26.0	56.1	-24.0	52.6	-25.0	52.6	-25.0	54.4	-24.0	49.1	-24.5	63.2	-19.5	63.2	-17.5	66.7	-19.5	68.4	-22.0
Desalination	68.4	-21.0	68.4	-23.0	57.9	-28.0	59.6	-28.0	56.1	-31.0	56.1	-31.0	59.6	-26.0	54.4	-28.0	64.9	-19.0	64.9	-20.0	70.2	-20.5	71.9	-24.0

Table 17. Monthly Flow Statistics for the American River at Nimbus Dam under Future Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM												
Existing condition	37.0	0.0	35.0	0.0	35.0	0.0	21.0	0.0	24.2	0.0	23.0	0.0
Future conditions												
No project	33.0	-4.0	30.0	-5.0	36.0	1.0	20.0	-1.0	19.3	-4.8	24.0	1.0
LV - Old River	33.0	-4.0	34.0	-1.0	36.0	1.0	20.0	-1.0	19.3	-4.8	23.0	0.0
LV - Clifton Cour	33.0	-4.0	34.0	-1.0	36.0	1.0	20.0	-1.0	19.3	-4.8	23.0	0.0
Middle River	33.0	-4.0	30.0	-5.0	36.0	1.0	20.0	-1.0	19.3	-4.8	24.0	1.0
Desalination	33.0	-4.0	28.0	-7.0	36.0	1.0	20.0	-1.0	19.3	-4.8	24.0	1.0
MEDIAN												
Existing condition	128.0	0.0	99.0	0.0	120.0	0.0	98.0	0.0	154.5	0.0	185.0	0.0
Future conditions												
No project	89.0	-39.0	77.0	-22.0	85.0	-35.0	147.0	49.0	151.6	-2.9	216.0	31.0
LV - Old River	89.0	-39.0	77.0	-22.0	84.0	-36.0	144.0	46.0	151.6	-2.9	216.0	31.0
LV - Clifton Cour	89.0	-39.0	77.0	-22.0	84.0	-36.0	143.0	45.0	151.6	-2.9	216.0	31.0
Middle River	89.0	-39.0	77.0	-22.0	85.0	-35.0	147.0	49.0	151.6	-2.9	216.0	31.0
Desalination	89.0	-39.0	77.0	-22.0	85.0	-35.0	143.0	45.0	151.6	-2.9	216.0	31.0
AVERAGE												
Existing condition	123.7	0.0	133.0	0.0	207.0	0.0	232.8	0.0	222.1	0.0	237.7	0.0
Future conditions												
No project	93.7	-30.1	101.9	-31.1	170.1	-36.9	235.1	2.3	216.9	-5.2	248.6	10.9
LV - Old River	93.1	-30.6	102.4	-30.7	170.3	-36.7	235.6	2.7	217.1	-5.0	248.3	10.6
LV - Clifton Cour	93.2	-30.6	102.4	-30.6	170.5	-36.5	235.6	2.8	217.2	-4.9	248.2	10.6
Middle River	93.7	-30.1	101.9	-31.1	170.1	-36.9	235.1	2.3	216.9	-5.2	248.6	10.9
Desalination	93.8	-30.0	101.1	-31.9	169.9	-37.1	235.1	2.2	216.7	-5.4	248.5	10.8
MAXIMUM												
Existing condition	301.0	0.0	853.0	0.0	1110.0	0.0	1279.0	0.0	795.0	0.0	930.0	0.0
Future conditions												
No project	198.0	-103.0	735.0	-118.0	1036.0	-74.0	1271.0	-8.0	729.0	-66.0	870.0	-60.0
LV - Old River	198.0	-103.0	736.0	-117.0	1036.0	-74.0	1271.0	-8.0	729.0	-66.0	870.0	-60.0
LV - Clifton Cour	198.0	-103.0	735.0	-118.0	1036.0	-74.0	1271.0	-8.0	729.0	-66.0	870.0	-60.0
Middle River	198.0	-103.0	735.0	-118.0	1036.0	-74.0	1271.0	-8.0	729.0	-66.0	870.0	-60.0
Desalination	198.0	-103.0	734.0	-119.0	1034.0	-76.0	1271.0	-8.0	729.0	-66.0	870.0	-60.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES												
No project	8.8	8.0	12.3	18.0	5.3	1.0	40.4	49.0	50.9	17.4	59.6	29.0
LV - Old River	8.8	2.0	12.3	18.0	5.3	2.0	40.4	49.0	50.9	17.4	57.9	29.0
LV - Clifton Cour	8.8	2.0	12.3	18.0	5.3	2.0	40.4	49.0	50.9	17.4	57.9	29.0
Middle River	8.8	8.0	12.3	18.0	5.3	1.0	40.4	49.0	50.9	17.4	59.6	29.0
Desalination	10.5	13.0	12.3	18.0	5.3	1.0	40.4	49.0	50.9	17.4	59.6	29.0
DECREASES												
No project	89.5	-35.0	82.5	-25.9	89.5	-27.0	54.4	-16.0	42.1	-41.3	38.6	-26.0
LV - Old River	89.5	-34.0	82.5	-25.9	89.5	-27.0	54.4	-16.0	42.1	-41.3	40.4	-23.0
LV - Clifton Cour	89.5	-34.0	82.5	-25.0	89.5	-27.0	54.4	-16.0	42.1	-41.3	40.4	-23.0
Middle River	89.5	-35.0	82.5	-25.9	89.5	-27.0	54.4	-16.0	42.1	-41.3	38.6	-26.0
Desalination	87.7	-36.0	80.7	-26.0	89.5	-26.0	54.4	-16.0	42.1	-41.3	38.6	-26.0

	APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM												
Existing condition	21.0	0.0	25.0	0.0	27.0	0.0	32.0	0.0	29.0	0.0	34.0	0.0
Future conditions												
No project	19.0	-2.0	20.0	-5.0	25.0	-2.0	24.0	-8.0	23.0	-6.0	27.0	-7.0
LV - Old River	20.0	-1.0	20.0	-5.0	25.0	-2.0	24.0	-8.0	23.0	-6.0	27.0	-7.0
LV - Clifton Cour	20.0	-1.0	20.0	-5.0	25.0	-2.0	24.0	-8.0	23.0	-6.0	27.0	-7.0
Middle River	19.0	-2.0	20.0	-5.0	25.0	-2.0	24.0	-8.0	23.0	-6.0	27.0	-7.0
Desalination	19.0	-2.0	20.0	-5.0	25.0	-2.0	24.0	-8.0	23.0	-6.0	27.0	-7.0
MEDIAN												
Existing condition	150.0	0.0	297.0	0.0	209.0	0.0	229.0	0.0	195.0	0.0	130.0	0.0
Future conditions												
No project	194.0	44.0	112.0	-185.0	165.0	-44.0	168.0	-61.0	141.0	-54.0	101.0	-29.0
LV - Old River	194.0	44.0	112.0	-185.0	164.0	-45.0	168.0	-61.0	139.0	-56.0	101.0	-29.0
LV - Clifton Cour	194.0	44.0	112.0	-185.0	164.0	-45.0	168.0	-61.0	140.0	-55.0	101.0	-29.0
Middle River	194.0	44.0	112.0	-185.0	165.0	-44.0	168.0	-61.0	141.0	-54.0	101.0	-29.0
Desalination	194.0	44.0	112.0	-185.0	165.0	-44.0	171.0	-58.0	143.0	-52.0	101.0	-29.0
AVERAGE												
Existing condition	189.9	0.0	311.1	0.0	241.8	0.0	224.9	0.0	177.0	0.0	118.7	0.0
Future conditions												
No project	204.9	15.0	183.9	-127.2	196.0	-45.8	178.2	-46.7	145.2	-31.7	100.4	-18.2
LV - Old River	204.9	14.9	184.2	-127.0	195.6	-46.2	177.2	-47.7	145.2	-31.7	101.0	-17.6
LV - Clifton Cour	204.8	14.9	184.1	-127.0	195.5	-46.3	177.0	-47.9	145.2	-31.8	101.1	-17.6
Middle River	204.9	15.0	183.9	-127.2	196.0	-45.8	178.2	-46.7	145.2	-31.7	100.4	-18.2
Desalination	204.6	14.6	184.1	-127.0	196.4	-45.4	179.1	-45.8	146.1	-30.8	99.8	-18.9
MAXIMUM												
Existing condition	523.0	0.0	910.0	0.0	635.0	0.0	361.0	0.0	281.0	0.0	184.0	0.0
Future conditions												
No project	587.0	64.0	690.0	-220.0	576.0	-59.0	463.0	102.0	331.0	50.0	134.0	-50.0
LV - Old River	587.0	64.0	690.0	-220.0	576.0	-59.0	452.0	91.0	314.0	33.0	149.0	-35.0
LV - Clifton Cour	587.0	64.0	690.0	-220.0	576.0	-59.0	452.0	91.0	313.0	32.0	151.0	-33.0
Middle River	587.0	64.0	690.0	-220.0	576.0	-59.0	463.0	102.0	331.0	50.0	134.0	-50.0
Desalination	587.0	64.0	690.0	-220.0	576.0	-59.0	468.0	107.0	361.0	80.0	134.0	-50.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES												
No project	57.9	42.0	0.0	0.0	3.5	2.5	14.0	76.5	17.5	15.0	8.8	12.0
LV - Old River	57.9	42.0	0.0	0.0	3.5	2.5	14.0	70.0	15.8	16.0	8.8	30.0
LV - Clifton Cour	57.9	42.0	0.0	0.0	3.5	1.5	14.0	70.0	15.8	16.0	8.8	32.0
Middle River	57.9	42.0	0.0	0.0	3.5	2.5	14.0	76.5	17.5	15.0	8.8	12.0
Desalination	57.9	42.0	0.0	0.0	3.5	3.0	14.0	81.0	17.5	16.5	7.0	26.0
DECREASES												
No project	42.1	-23.5	100.0	-139.9	96.5	-43.0	86.0	-54.0	82.5	-37.0	89.5	-20.0
LV - Old River	42.1	-24.5	100.0	-139.9	96.5	-44.0	86.0	-54.0	82.5	-37.0	89.5	-20.0
LV - Clifton Cour	42.1	-24.5	100.0	-139.9	96.5	-44.0	86.0	-54.0	82.5	-37.0	89.5	-20.0
Middle River	42.1	-23.5	100.0	-139.9	96.5	-43.0	86.0	-54.0	82.5	-37.0	89.5	-20.0
Desalination	42.1	-23.5	100.0	-139.9	96.5	-43.0	86.0	-54.0	82.5	-37.0	91.2	-20.0

Table 18. Monthly Flow Statistics for the Trinity River at Lewiston Dam under Future Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM																								
Existing condition	14.0	0.0	14.0	0.0	9.0	0.0	9.0	0.0	8.7	0.0	9.0	0.0	9.0	0.0	9.0	0.0	15.0	0.0	16.0	0.0	15.0	0.0	12.0	0.0
Future conditions																								
No project	14.0	0.0	14.0	0.0	9.0	0.0	9.0	0.0	8.7	0.0	9.0	0.0	9.0	0.0	9.0	0.0	15.0	0.0	16.0	0.0	15.0	0.0	12.0	0.0
LV - Old River	14.0	0.0	14.0	0.0	9.0	0.0	9.0	0.0	8.7	0.0	9.0	0.0	9.0	0.0	9.0	0.0	15.0	0.0	16.0	0.0	15.0	0.0	12.0	0.0
LV - Clifton Court	14.0	0.0	14.0	0.0	9.0	0.0	9.0	0.0	8.7	0.0	9.0	0.0	9.0	0.0	9.0	0.0	15.0	0.0	16.0	0.0	15.0	0.0	12.0	0.0
Middle River	14.0	0.0	14.0	0.0	9.0	0.0	9.0	0.0	8.7	0.0	9.0	0.0	9.0	0.0	9.0	0.0	15.0	0.0	16.0	0.0	15.0	0.0	12.0	0.0
Desalination	14.0	0.0	14.0	0.0	9.0	0.0	9.0	0.0	8.7	0.0	9.0	0.0	9.0	0.0	9.0	0.0	15.0	0.0	16.0	0.0	15.0	0.0	12.0	0.0
MEDIAN																								
Existing condition	18.0	0.0	18.0	0.0	18.0	0.0	18.0	0.0	16.4	0.0	28.0	0.0	36.0	0.0	55.0	0.0	46.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
Future conditions																								
No project	18.0	0.0	18.0	0.0	18.0	0.0	18.0	0.0	16.4	0.0	28.0	0.0	36.0	0.0	55.0	0.0	46.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
LV - Old River	18.0	0.0	18.0	0.0	18.0	0.0	18.0	0.0	16.4	0.0	28.0	0.0	36.0	0.0	55.0	0.0	46.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
LV - Clifton Court	18.0	0.0	18.0	0.0	18.0	0.0	18.0	0.0	16.4	0.0	28.0	0.0	36.0	0.0	55.0	0.0	46.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
Middle River	18.0	0.0	18.0	0.0	18.0	0.0	18.0	0.0	16.4	0.0	28.0	0.0	36.0	0.0	55.0	0.0	46.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
Desalination	18.0	0.0	18.0	0.0	18.0	0.0	18.0	0.0	16.4	0.0	28.0	0.0	36.0	0.0	55.0	0.0	46.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
AVERAGE																								
Existing condition	17.6	0.0	17.6	0.0	17.1	0.0	18.5	0.0	15.8	0.0	25.2	0.0	34.0	0.0	66.2	0.0	42.8	0.0	34.5	0.0	25.4	0.0	17.4	0.0
Future conditions																								
No project	17.6	0.0	17.6	0.0	17.1	0.0	18.0	-0.5	15.8	0.0	25.2	0.0	32.9	-1.1	66.3	0.1	42.8	0.0	34.5	0.0	25.4	0.0	17.4	0.0
LV - Old River	17.6	0.0	17.6	0.0	17.1	0.0	18.0	-0.4	15.8	0.0	25.2	0.0	33.1	-0.9	66.3	0.1	42.8	0.0	34.5	0.0	25.4	0.0	17.4	0.0
LV - Clifton Court	17.6	0.0	17.6	0.0	17.1	0.0	18.0	-0.5	15.8	0.0	25.2	0.0	33.0	-1.0	66.3	0.1	42.8	0.0	34.5	0.0	25.4	0.0	17.4	0.0
Middle River	17.6	0.0	17.6	0.0	17.1	0.0	18.0	-0.5	15.8	0.0	25.2	0.0	32.9	-1.1	66.3	0.1	42.8	0.0	34.5	0.0	25.4	0.0	17.4	0.0
Desalination	17.6	0.0	17.6	0.0	17.1	0.0	18.0	-0.5	15.8	0.0	25.2	0.0	32.7	-1.3	66.3	0.1	42.8	0.0	34.5	0.0	25.4	0.0	17.4	0.0
MAXIMUM																								
Existing condition	18.0	0.0	18.0	0.0	18.0	0.0	97.0	0.0	17.0	0.0	48.0	0.0	114.0	0.0	348.0	0.0	137.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
Future conditions																								
No project	18.0	0.0	18.0	0.0	18.0	0.0	71.0	-26.0	17.0	0.0	48.0	0.0	112.0	-2.0	348.0	0.0	137.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
LV - Old River	18.0	0.0	18.0	0.0	18.0	0.0	72.0	-25.0	17.0	0.0	48.0	0.0	112.0	-2.0	348.0	0.0	137.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
LV - Clifton Court	18.0	0.0	18.0	0.0	18.0	0.0	71.0	-26.0	17.0	0.0	48.0	0.0	112.0	-2.0	348.0	0.0	137.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
Middle River	18.0	0.0	18.0	0.0	18.0	0.0	71.0	-26.0	17.0	0.0	48.0	0.0	112.0	-2.0	348.0	0.0	137.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
Desalination	18.0	0.0	18.0	0.0	18.0	0.0	71.0	-26.0	17.0	0.0	48.0	0.0	112.0	-2.0	348.0	0.0	137.0	0.0	40.0	0.0	28.0	0.0	18.0	0.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES																								
No project	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LV - Old River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LV - Clifton Court	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DECREASES																								
No project	0.0	0.0	0.0	0.0	0.0	0.0	1.8	-26.0	0.0	0.0	0.0	0.0	1.8	-61.0	1.8	-1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LV - Old River	0.0	0.0	0.0	0.0	0.0	0.0	1.8	-25.0	0.0	0.0	0.0	0.0	1.8	-53.0	1.8	-1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LV - Clifton Court	0.0	0.0	0.0	0.0	0.0	0.0	1.8	-26.0	0.0	0.0	0.0	0.0	1.8	-55.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Middle River	0.0	0.0	0.0	0.0	0.0	0.0	1.8	-26.0	0.0	0.0	0.0	0.0	1.8	-61.0	1.8	-1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desalination	0.0	0.0	0.0	0.0	0.0	0.0	1.8	-26.0	0.0	0.0	0.0	0.0	1.8	-75.0	1.8	-1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 19. Monthly Flow Statistics for the Sacramento River at Keswick Dam under Future Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM																								
Existing condition	193.0	0.0	232.0	0.0	123.0	0.0	123.0	0.0	107.0	0.0	141.0	0.0	137.0	0.0	141.0	0.0	408.0	0.0	577.0	0.0	436.0	0.0	167.0	0.0
Future conditions																								
No project	180.0	-13.0	232.0	0.0	123.0	0.0	123.0	0.0	107.0	0.0	141.0	0.0	137.0	0.0	141.0	0.0	379.0	-29.0	618.0	41.0	437.0	1.0	188.0	21.0
LV - Old River	174.0	-19.0	222.0	-10.0	123.0	0.0	123.0	0.0	107.0	0.0	141.0	0.0	137.0	0.0	141.0	0.0	379.0	-29.0	621.0	44.0	437.0	1.0	188.0	21.0
LV - Clifton Court	173.0	-20.0	222.0	-10.0	123.0	0.0	123.0	0.0	107.0	0.0	141.0	0.0	137.0	0.0	141.0	0.0	379.0	-29.0	618.0	41.0	437.0	1.0	188.0	21.0
Middle River	180.0	-13.0	232.0	0.0	123.0	0.0	123.0	0.0	107.0	0.0	141.0	0.0	137.0	0.0	141.0	0.0	379.0	-29.0	618.0	41.0	437.0	1.0	188.0	21.0
Desalination	180.0	-13.0	232.0	0.0	123.0	0.0	123.0	0.0	107.0	0.0	141.0	0.0	137.0	0.0	141.0	0.0	380.0	-28.0	612.0	35.0	437.0	1.0	188.0	21.0
MEDIAN																								
Existing condition	322.0	0.0	325.0	0.0	333.0	0.0	230.0	0.0	263.0	0.0	320.0	0.0	398.0	0.0	519.0	0.0	670.0	0.0	932.0	0.0	707.0	0.0	355.0	0.0
Future conditions																								
No project	343.0	21.0	334.0	9.0	322.0	-11.0	186.0	-44.0	263.0	0.0	300.0	-20.0	423.0	25.0	507.0	-12.0	668.0	-2.0	901.0	-31.0	844.0	137.0	381.0	26.0
LV - Old River	343.0	21.0	331.0	6.0	319.0	-14.0	195.0	-35.0	263.0	0.0	300.0	-20.0	423.0	25.0	507.0	-12.0	668.0	-2.0	901.0	-31.0	844.0	137.0	379.0	24.0
LV - Clifton Court	343.0	21.0	334.0	9.0	322.0	-11.0	195.0	-35.0	263.0	0.0	300.0	-20.0	423.0	25.0	507.0	-12.0	661.0	-9.0	901.0	-31.0	844.0	137.0	379.0	24.0
Middle River	343.0	21.0	334.0	9.0	322.0	-11.0	186.0	-44.0	263.0	0.0	300.0	-20.0	423.0	25.0	507.0	-12.0	668.0	-2.0	901.0	-31.0	844.0	137.0	381.0	26.0
Desalination	344.0	22.0	346.0	21.0	323.0	-10.0	187.0	-43.0	263.0	0.0	300.0	-20.0	423.0	25.0	508.0	-11.0	668.0	-2.0	894.0	-38.0	845.0	138.0	382.0	27.0
AVERAGE																								
Existing condition	366.0	0.0	381.0	0.0	470.0	0.0	527.0	0.0	512.0	0.0	508.0	0.0	461.0	0.0	559.0	0.0	648.0	0.0	908.0	0.0	743.0	0.0	360.0	0.0
Future conditions																								
No project	371.0	4.0	378.0	-3.0	438.0	-32.0	515.0	-12.0	497.0	-15.0	501.0	-7.0	453.0	-9.0	557.0	-2.0	656.0	8.0	895.0	-13.0	793.0	50.0	395.0	35.0
LV - Old River	369.0	3.0	377.0	-4.0	440.0	-30.0	515.0	-12.0	499.0	-13.0	502.0	-6.0	453.0	-9.0	556.0	-3.0	655.0	7.0	894.0	-14.0	793.0	50.0	394.0	34.0
LV - Clifton Court	370.0	3.0	377.0	-4.0	441.0	-29.0	515.0	-12.0	498.0	-13.0	502.0	-6.0	453.0	-9.0	556.0	-3.0	655.0	7.0	893.0	-15.0	793.0	50.0	394.0	35.0
Middle River	371.0	4.0	378.0	-3.0	438.0	-32.0	515.0	-12.0	497.0	-15.0	501.0	-7.0	453.0	-9.0	557.0	-2.0	656.0	8.0	895.0	-13.0	793.0	50.0	395.0	35.0
Desalination	372.0	6.0	379.0	-2.0	437.0	-34.0	515.0	-12.0	495.0	-17.0	501.0	-7.0	453.0	-8.0	557.0	-2.0	656.0	8.0	895.0	-13.0	793.0	50.0	396.0	36.0
MAXIMUM																								
Existing condition	703.0	0.0	1823.0	0.0	1411.0	0.0	3226.0	0.0	1808.0	0.0	2753.0	0.0	1778.0	0.0	1060.0	0.0	853.0	0.0	1113.0	0.0	995.0	0.0	671.0	0.0
Future conditions																								
No project	709.0	6.0	1364.0	-459.0	1407.0	-4.0	3226.0	0.0	1808.0	0.0	2753.0	0.0	1778.0	0.0	1060.0	0.0	976.0	123.0	1215.0	102.0	1053.0	58.0	646.0	-25.0
LV - Old River	709.0	6.0	1382.0	-441.0	1407.0	-4.0	3226.0	0.0	1808.0	0.0	2753.0	0.0	1778.0	0.0	1060.0	0.0	968.0	115.0	1216.0	103.0	1053.0	58.0	646.0	-25.0
LV - Clifton Court	709.0	6.0	1364.0	-459.0	1407.0	-4.0	3226.0	0.0	1808.0	0.0	2753.0	0.0	1778.0	0.0	1060.0	0.0	976.0	123.0	1216.0	103.0	1053.0	58.0	646.0	-25.0
Middle River	709.0	6.0	1364.0	-459.0	1407.0	-4.0	3226.0	0.0	1808.0	0.0	2753.0	0.0	1778.0	0.0	1060.0	0.0	976.0	123.0	1215.0	102.0	1053.0	58.0	646.0	-25.0
Desalination	709.0	6.0	1362.0	-461.0	1407.0	-4.0	3226.0	0.0	1808.0	0.0	2753.0	0.0	1778.0	0.0	1060.0	0.0	976.0	123.0	1216.0	103.0	1054.0	59.0	646.0	-25.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES																								
No project	49.1	33.0	56.1	20.5	40.4	25.0	21.1	22.0	19.3	22.2	19.3	21.0	17.5	24.5	33.3	36.0	45.6	45.0	35.1	53.5	54.4	111.0	75.4	48.0
LV - Old River	49.1	29.5	54.4	18.0	40.4	24.0	21.1	22.0	19.3	22.2	19.3	21.0	17.5	26.5	33.3	36.0	45.6	43.0	35.1	46.0	54.4	111.0	73.7	49.0
LV - Clifton Court	49.1	32.5	56.1	20.5	40.4	24.0	21.1	22.0	19.3	22.2	19.3	21.0	17.5	26.5	33.3	36.0	45.6	42.5	35.1	49.0	54.4	108.0	73.7	50.0
Middle River	49.1	33.0	56.1	20.5	40.4	25.0	21.1	22.0	19.3	22.2	19.3	21.0	17.5	24.5	33.3	36.0	45.6	45.0	35.1	53.5	54.4	111.0	75.4	48.0
Desalination	50.9	34.0	56.1	22.0	40.4	25.0	21.1	23.0	19.3	21.2	19.3	23.0	17.5	25.0	33.3	36.0	45.6	45.0	35.1	55.5	54.4	113.0	75.4	48.0
DECREASES																								
No project	42.1	-17.5	28.1	-34.5	35.1	-62.0	24.6	-36.0	24.6	-23.1	21.1	-41.5	40.4	-29.0	38.6	-41.0	35.1	-33.5	64.9	-43.0	43.9	-42.0	22.8	-3.0
LV - Old River	42.1	-17.0	29.8	-35.0	35.1	-61.5	24.6	-36.0	22.8	-26.0	21.1	-41.0	40.4	-29.0	38.6	-41.0	35.1	-33.5	64.9	-43.0	43.9	-42.0	24.6	-4.0
LV - Clifton Court	42.1	-17.0	28.1	-36.5	35.1	-56.0	24.6	-36.0	22.8	-26.0	21.1	-41.0	40.4	-30.1	38.6	-41.0	35.1	-33.5	64.9	-43.0	43.9	-42.0	22.8	-5.0
Middle River	42.1	-17.5	28.1	-34.5	35.1	-62.0	24.6	-36.0	24.6	-23.1	21.1	-41.5	40.4	-29.0	38.6	-41.0	35.1	-33.5	64.9	-43.0	43.9	-42.0	22.8	-3.0
Desalination	40.4	-16.0	26.3	-36.0	35.1	-63.5	24.6	-35.5	24.6	-25.5	21.1	-42.0	40.4	-29.0	38.6	-41.0	35.1	-33.0	64.9	-43.0	42.1	-43.5	21.1	-4.0

Table 20. Monthly Flow Statistics for the Sacramento River at Sacramento under Future Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM																								
Existing condition	285.0	0.0	518.0	0.0	606.0	0.0	588.0	0.0	503.0	0.0	445.0	0.0	410.0	0.0	508.0	0.0	462.0	0.0	504.0	0.0	370.0	0.0	334.0	0.0
Future conditions																								
No project	335.0	50.0	483.0	-35.0	573.0	-33.0	601.0	13.0	547.0	44.0	374.0	-71.0	355.0	-55.0	480.0	-28.0	434.0	-28.0	479.0	-25.0	383.0	13.0	387.0	53.0
LV - Old River	335.0	50.0	483.0	-35.0	573.0	-33.0	601.0	13.0	547.0	44.0	374.0	-71.0	355.0	-55.0	480.0	-28.0	434.0	-28.0	479.0	-25.0	383.0	13.0	387.0	53.0
LV - Clifton Court	335.0	50.0	483.0	-35.0	573.0	-33.0	601.0	13.0	547.0	44.0	374.0	-71.0	355.0	-55.0	480.0	-28.0	434.0	-28.0	479.0	-25.0	383.0	13.0	387.0	53.0
Middle River	335.0	50.0	483.0	-35.0	573.0	-33.0	601.0	13.0	547.0	44.0	374.0	-71.0	355.0	-55.0	480.0	-28.0	434.0	-28.0	479.0	-25.0	383.0	13.0	387.0	53.0
Desalination	342.0	57.0	485.0	-33.0	575.0	-31.0	601.0	13.0	548.0	45.0	376.0	-69.0	356.0	-54.0	480.0	-28.0	437.0	-25.0	481.0	-23.0	383.0	13.0	387.0	53.0
MEDIAN																								
Existing condition	784.0	0.0	905.0	0.0	973.0	0.0	1141.0	0.0	1574.0	0.0	1367.0	0.0	1096.0	0.0	1062.0	0.0	906.0	0.0	1120.0	0.0	858.0	0.0	606.0	0.0
Future conditions																								
No project	657.0	-127.0	873.0	-32.0	970.0	-3.0	1180.0	39.0	1600.0	26.0	1414.0	47.0	1035.0	-61.0	975.0	-87.0	911.0	5.0	1140.0	20.0	974.0	116.0	802.0	196.0
LV - Old River	657.0	-127.0	869.0	-36.0	970.0	-3.0	1195.0	54.0	1600.0	26.0	1414.0	47.0	1035.0	-61.0	975.0	-87.0	911.0	5.0	1140.0	20.0	974.0	116.0	802.0	196.0
LV - Clifton Court	657.0	-127.0	873.0	-32.0	970.0	-3.0	1195.0	54.0	1600.0	26.0	1414.0	47.0	1035.0	-61.0	975.0	-87.0	911.0	5.0	1133.0	13.0	974.0	116.0	802.0	196.0
Middle River	657.0	-127.0	873.0	-32.0	970.0	-3.0	1180.0	39.0	1600.0	26.0	1414.0	47.0	1035.0	-61.0	975.0	-87.0	911.0	5.0	1140.0	20.0	974.0	116.0	802.0	196.0
Desalination	658.0	-126.0	874.0	-31.0	970.0	-3.0	1180.0	39.0	1600.0	26.0	1414.0	47.0	1035.0	-61.0	975.0	-87.0	911.0	5.0	1141.0	21.0	976.0	118.0	803.0	197.0
AVERAGE																								
Existing condition	822.0	0.0	1032.0	0.0	1455.0	0.0	1821.0	0.0	1908.0	0.0	1882.0	0.0	1408.0	0.0	1373.0	0.0	1027.0	0.0	1058.0	0.0	846.0	0.0	617.0	0.0
Future conditions																								
No project	728.0	-93.0	911.0	-121.0	1284.0	-171.0	1749.0	-73.0	1838.0	-70.0	1875.0	-8.0	1365.0	-43.0	1262.0	-111.0	1008.0	-18.0	1103.0	45.0	943.0	98.0	738.0	121.0
LV - Old River	726.0	-95.0	911.0	-121.0	1286.0	-169.0	1750.0	-72.0	1840.0	-68.0	1875.0	-7.0	1365.0	-43.0	1261.0	-111.0	1007.0	-19.0	1101.0	43.0	943.0	97.0	738.0	121.0
LV - Clifton Court	727.0	-95.0	911.0	-121.0	1288.0	-167.0	1750.0	-71.0	1840.0	-68.0	1875.0	-7.0	1365.0	-43.0	1261.0	-112.0	1006.0	-20.0	1100.0	42.0	943.0	98.0	738.0	121.0
Middle River	728.0	-93.0	911.0	-121.0	1284.0	-171.0	1749.0	-73.0	1838.0	-70.0	1875.0	-8.0	1365.0	-43.0	1262.0	-111.0	1008.0	-18.0	1103.0	45.0	943.0	98.0	738.0	121.0
Desalination	730.0	-92.0	912.0	-120.0	1283.0	-172.0	1749.0	-73.0	1836.0	-72.0	1875.0	-8.0	1365.0	-43.0	1262.0	-111.0	1009.0	-18.0	1104.0	46.0	944.0	98.0	739.0	121.0
MAXIMUM																								
Existing condition	1584.0	0.0	3333.0	0.0	4234.0	0.0	5678.0	0.0	4714.0	0.0	5664.0	0.0	4163.0	0.0	4030.0	0.0	2435.0	0.0	1339.0	0.0	1177.0	0.0	1052.0	0.0
Future conditions																								
No project	1393.0	-191.0	2071.0	-1262	3734.0	-500.0	5573.0	-105.0	4093.0	-621.0	5517.0	-147.0	4146.0	-17.0	3797.0	-233.0	2325.0	-110.0	1319.0	-20.0	1278.0	101.0	998.0	-54.0
LV - Old River	1393.0	-191.0	2091.0	-1242	3734.0	-500.0	5573.0	-105.0	4093.0	-621.0	5517.0	-147.0	4146.0	-17.0	3797.0	-233.0	2325.0	-110.0	1319.0	-20.0	1278.0	101.0	998.0	-54.0
LV - Clifton Court	1393.0	-191.0	2071.0	-1262	3734.0	-500.0	5573.0	-105.0	4093.0	-621.0	5517.0	-147.0	4146.0	-17.0	3797.0	-233.0	2325.0	-110.0	1319.0	-20.0	1278.0	101.0	998.0	-54.0
Middle River	1393.0	-191.0	2071.0	-1262	3734.0	-500.0	5573.0	-105.0	4093.0	-621.0	5517.0	-147.0	4146.0	-17.0	3797.0	-233.0	2325.0	-110.0	1319.0	-20.0	1278.0	101.0	998.0	-54.0
Desalination	1393.0	-191.0	2069.0	-1264	3734.0	-500.0	5573.0	-105.0	4093.0	-621.0	5517.0	-147.0	4146.0	-17.0	3797.0	-233.0	2325.0	-110.0	1319.0	-20.0	1279.0	102.0	999.0	-53.0
	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)	Freq. (%)	Median (TAF)
INCREASES																								
No project	17.5	27.0	24.6	11.5	26.3	60.0	31.6	97.0	40.4	33.8	50.9	45.0	50.9	34.0	8.8	17.0	42.1	15.0	61.4	57.0	82.5	123.0	77.2	164.0
LV - Old River	14.0	40.0	21.1	23.5	26.3	59.0	31.6	97.0	42.1	33.8	50.9	45.0	50.9	34.0	8.8	12.0	40.4	16.0	59.6	63.0	82.5	123.0	77.2	164.0
LV - Clifton Court	14.0	40.0	24.6	11.5	26.3	60.0	31.6	97.0	42.1	33.8	50.9	45.0	50.9	34.0	7.0	14.0	36.8	16.0	57.9	69.0	82.5	123.0	77.2	164.0
Middle River	17.5	27.0	24.6	11.5	26.3	60.0	31.6	97.0	40.4	33.8	50.9	45.0	50.9	34.0	8.8	17.0	42.1	15.0	61.4	57.0	82.5	123.0	77.2	164.0
Desalination	21.1	17.0	24.6	13.5	26.3	61.1	31.6	96.5	40.4	33.8	50.9	45.0	52.6	33.0	8.8	19.0	43.9	16.0	61.4	57.0	82.5	124.0	77.2	164.0
DECREASES																								
No project	82.5	-114.0	75.4	-74.0	73.7	-145.5	68.4	-109.0	59.6	-84.9	49.1	-48.0	49.1	-89.5	91.2	-88.5	57.9	-24.0	38.6	-21.0	17.5	-81.5	22.8	-20.0
LV - Old River	86.0	-114.0	78.9	-73.0	73.7	-145.5	68.4	-109.0	57.9	-92.7	49.1	-48.0	49.1	-91.0	91.2	-88.5	59.6	-23.0	40.4	-20.0	17.5	-83.0	22.8	-20.0
LV - Clifton Court	86.0	-114.0	75.4	-74.0	73.7	-145.5	68.4	-109.0	57.9	-92.7	49.1	-48.0	49.1	-89.5	93.0	-86.0	63.2	-23.5	40.4	-21.0	17.5	82.0	22.8	-20.0
Middle River	82.5	-114.0	75.4	-74.0	73.7	-145.5	68.4	-109.0	59.6	-84.9	49.1	-48.0	49.1	-89.5	91.2	-88.5	57.9	-24.0	38.6	-21.0	17.5	-81.5	22.8	-20.0
Desalination	77.2	-122.5	75.4	-76.0	73.7	-145.0	68.4	-109.0	59.6	-84.9	49.1	-48.0	47.4	-89.0	91.2	-88.0	54.4	-25.0	38.6	-20.5	17.5	-81.0	22.8	-20.0

Table 21. Monthly Flow Statistics for Delta Inflow under Existing, Future, and Future Cumulative Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change
Demand Conditions	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF
MINIMUM																								
Existing	449	0	691	0	733	0	728	0	652	0	679	0	697	0	730	0	670	0	718	0	556	0	486	0
Future	462	13	618	-73	752	19	774	46	689	37	586	-93	604	-93	685	-45	600	-70	639	-79	524	-32	522	36
Future cumulative	452	3	616	-75	719	-14	699	-29	558	-94	583	-96	603	-94	685	-45	594	-76	650	-68	538	-18	522	36
MEDIAN																								
Existing	1039	0	1085	0	1183	0	1558	0	2012	0	1744	0	1321	0	1417	0	1136	0	1300	0	1029	0	759	0
Future	861	-178	1045	-40	1206	23	1594	36	2055	43	1716	-28	1317	-4	1208	-209	1149	13	1318	18	1149	120	998	239
Future cumulative	934	-105	1173	88	1275	92	1584	26	2055	43	1729	-15	1460	139	1209	-208	1082	-54	1095	-205	989	-40	877	118
AVERAGE																								
Existing	1100	0	1274	0	2005	0	2791	0	2970	0	2609	0	2010	0	1710	0	1321	0	1258	0	1020	0	791	0
Future	989	-111	1147	-127	1825	-180	2713	-78	2885	-85	2582	-27	1980	-30	1589	-121	1295	-26	1309	51	1116	96	916	125
Future cumulative	1094	-6	1304	30	1906	-99	2782	-9	2895	-75	2627	18	2018	8	1559	-151	1242	-79	1071	-187	964	-56	875	84
MAXIMUM																								
Existing	2481	0	4404	0	6699	0	12899	0	9219	0	10200	0	6989	0	4957	0	3539	0	1619	0	1342	0	1318	0
Future	2286	-195	3088	-1316	5955	-744	12773	-126	9032	-187	9938	-262	7042	53	4631	-326	3396	-143	1494	-125	1431	89	1305	-13
Future cumulative	2285	-196	3846	-558	5968	-731	12773	-126	9130	-89	9938	-262	7042	53	4631	-326	3396	-143	1406	-213	1192	-150	1288	-30

Table 22. Monthly Flow Statistics for Delta Outflow under Existing, Future, and Future Cumulative Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change
Demand Conditions	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF
MINIMUM																								
Existing	215	0	211	0	277	0	277	0	250	0	277	0	268	0	277	0	229	0	237	0	194	0	149	0
Future	215	0	208	-3	235	-42	277	0	250	0	277	0	268	0	277	0	229	0	237	0	194	0	151	2
Future cumulative	215	0	208	-3	215	-62	277	0	250	0	277	0	268	0	277	0	229	0	237	0	194	0	149	0
MEDIAN																								
Existing	312	0	338	0	447	0	877	0	1379	0	1000	0	595	0	882	0	565	0	473	0	377	0	239	0
Future	277	-35	340	2	383	-64	844	-33	1356	-23	1053	53	595	0	663	-219	565	0	508	35	401	24	308	69
Future cumulative	277	-35	268	-70	277	-170	738	-139	1195	-184	794	-206	466	-129	663	-219	565	0	413	-60	278	-99	149	-90
AVERAGE																								
Existing	442	0	589	0	1237	0	2110	0	2333	0	1904	0	1325	0	1199	0	743	0	468	0	355	0	251	0
Future	376	-67	463	-125	1056	-181	2002	-108	2228	-105	1886	-18	1323	-1	1073	-125	710	-33	478	10	386	32	284	33
Future cumulative	378	-64	475	-114	989	-248	1937	-173	2110	-223	1757	-147	1215	-110	1074	-125	710	-33	432	-36	259	-96	155	-96
MAXIMUM																								
Existing	1610	0	3588	0	5944	0	12226	0	8585	0	9519	0	6227	0	4435	0	2909	0	755	0	485	0	549	0
Future	1378	-232	2240	-1348	5149	-795	12031	-195	8332	-253	9425	-94	6334	107	4098	-337	2752	-157	615	-140	523	38	497	-52
Future cumulative	1154	-456	2786	-802	4967	-977	12045	-181	8268	-317	9067	-452	6284	57	4097	-338	2751	-158	615	-140	305	-180	258	-291

Table 23. **Monthly Storage Statistics for Shasta Reservoir under Existing, Future, and Future Cumulative Conditions**

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
Demand Conditions	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF
MINIMUM																								
Existing	779	0	720	0	975	0	1086	0	1197	0	1658	0	1611	0	1561	0	1336	0	968	0	816	0	825	0
Future	393	-386	373	-347	383	-592	490	-596	573	-624	884	-774	997	-614	1022	-539	887	-449	637	-331	426	-390	349	-476
Future cumulative	374	-405	331	-389	353	-622	469	-617	554	-643	850	-808	954	-657	981	-580	849	-487	599	-369	394	-422	328	-497
MEDIAN																								
Existing	2838	0	2934	0	3293	0	3346	0	3588	0	3940	0	4289	0	4405	0	3949	0	3315	0	2909	0	2856	0
Future	2684	-154	2741	-193	3252	-41	3317	-29	3522	-66	3933	-7	4195	-94	4303	-102	3902	-47	3267	-48	2705	-204	2654	-202
Future cumulative	2581	-257	2710	-224	3246	-47	3252	-94	3480	-108	3873	-67	4193	-96	4272	-133	3854	-95	3242	-73	2795	-114	2575	-281
AVERAGE																								
Existing	2686	0	2681	0	2832	0	3061	0	3381	0	3671	0	3973	0	3991	0	3728	0	3199	0	2810	0	2747	0
Future	2512	-174	2511	-170	2693	-139	2933	-128	3267	-114	3565	-106	3875	-99	3896	-95	3627	-101	3109	-90	2671	-139	2575	-172
Future cumulative	2460	-226	2464	-217	2655	-177	2893	-168	3234	-147	3528	-143	3839	-134	3862	-129	3592	-136	3087	-112	2690	-120	2542	-205
MAXIMUM																								
Existing	3400	0	3252	0	3380	0	3725	0	4552	0	4318	0	4552	0	4552	0	4552	0	4300	0	4000	0	3700	0
Future	3400	0	3252	0	3380	0	3725	0	4552	0	4323	5	4552	0	4552	0	4552	0	4300	0	4000	0	3700	0
Future cumulative	3400	0	3252	0	3380	0	3725	0	4552	0	4318	0	4552	0	4552	0	4552	0	4300	0	4000	0	3700	0

Table 24. Monthly Storage Statistics for Folsom Reservoir under Existing, Future, and Future Cumulative Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Storage	Change	Storage	Change	Storage	Change	Storage	Change	Storage	Change	Storage	Change	Storage	Change	Storage	Change	Storage	Change	Storage	Change	Storage	Change	Storage	Change
Demand Conditions	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF
MINIMUM																								
Existing	69	0	61	0	152	0	203	0	194	0	193	0	195	0	199	0	177	0	131	0	107	0	82	0
Future	5	-64	1	-60	67	-85	123	-80	148	-46	173	-20	170	-25	170	-29	137	-40	85	-46	41	-66	17	-65
Future cumulative	1	-68	1	-60	64	-88	121	-82	143	-51	157	-36	155	-40	155	-44	122	-55	72	-59	28	-79	4	-78
MEDIAN																								
Existing	556	0	549	0	610	0	619	0	686	0	794	0	969	0	1010	0	961	0	793	0	639	0	594	0
Future	418	-138	440	-109	569	-41	610	-9	634	-52	700	-94	835	-134	984	-26	886	-75	662	-131	524	-115	439	-155
Future cumulative	420	-136	440	-109	552	-58	609	-10	630	-56	698	-96	835	-134	984	-26	886	-75	662	-131	527	-112	447	-147
AVERAGE																								
Existing	514	0	494	0	512	0	576	0	647	0	735	0	890	0	919	0	874	0	728	0	612	0	563	0
Future	418	-96	422	-72	470	-42	524	-52	591	-56	656	-79	767	-123	881	-38	825	-49	658	-70	517	-95	448	-116
Future cumulative	418	-96	419	-75	465	-47	521	-55	589	-58	654	-81	766	-124	879	-40	823	-51	657	-71	521	-91	448	-115
MAXIMUM																								
Existing	680	0	610	0	610	0	687	0	758	0	860	0	1010	0	1010	0	1010	0	960	0	860	0	780	0
Future	755	75	610	0	610	0	610	-77	660	-98	735	-125	835	-175	1010	0	1010	0	1010	50	930	70	872	92
Future cumulative	755	75	610	0	610	0	610	-77	660	-98	735	-125	835	-175	1010	0	1010	0	1010	50	919	59	861	81

Table 25. Monthly Storage Statistics for Clair Engle Reservoir under Existing, Future, and Future Cumulative Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
Demand Conditions	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF	Storage TAF	Change TAF
MINIMUM																								
Existing	305	0	302	0	313	0	305	0	309	0	391	0	527	0	628	0	694	0	514	0	342	0	313	0
Future	133	-172	87	-215	95	-218	164	-141	211	-98	317	-74	403	-124	447	-181	378	-316	313	-201	276	-66	190	-123
Future cumulative	103	-202	58	-244	62	-251	131	-174	165	-144	292	-99	384	-143	421	-207	360	-334	313	-201	255	-87	159	-154
MEDIAN																								
Existing	1619	0	1600	0	1668	0	1759	0	1797	0	1890	0	1989	0	2129	0	2098	0	1927	0	1758	0	1681	0
Future	1600	-19	1575	-25	1667	-1	1756	-3	1791	-6	1890	0	1979	-10	2093	-36	2089	-9	1884	-43	1716	-42	1618	-63
Future cumulative	1526	-93	1551	-49	1670	2	1734	-25	1789	-8	1887	-3	1958	-31	2065	-64	2077	-21	1876	-51	1706	-52	1605	-76
AVERAGE																								
Existing	1463	0	1465	0	1483	0	1563	0	1652	0	1765	0	1898	0	1989	0	1987	0	1820	0	1642	0	1538	0
Future	1442	-21	1444	-22	1462	-21	1542	-21	1632	-21	1745	-20	1878	-20	1967	-22	1963	-24	1798	-22	1624	-18	1519	-19
Future cumulative	1432	-31	1431	-34	1449	-34	1529	-34	1619	-33	1733	-32	1866	-32	1956	-33	1951	-36	1787	-33	1614	-28	1508	-30
MAXIMUM																								
Existing	2040	0	2094	0	2189	0	2448	0	2448	0	2448	0	2448	0	2448	0	2448	0	2400	0	2239	0	2133	0
Future	2048	8	2067	-27	2163	-26	2448	0	2448	0	2448	0	2448	0	2448	0	2448	0	2401	1	2243	4	2141	8
Future cumulative	2058	18	2062	-32	2158	-31	2448	0	2448	0	2448	0	2448	0	2448	0	2448	0	2401	1	2246	7	2152	19

Table 26. Monthly Flow Statistics for the American River at Nimbus Dam under Existing, Future, and Future Cumulative Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change
Demand Conditions	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF
MINIMUM																								
Existing	37	0	35	0	35	0	21	0	24	0	23	0	21	0	25	0	27	0	32	0	29	0	34	0
Future	33	-4	30	-5	36	1	20	-1	19	-5	24	1	19	-2	20	-5	25	-2	24	-8	23	-6	27	-7
Future cumulative	24	-13	25	-10	36	1	20	-1	27	3	24	1	19	-2	20	-5	25	-2	24	-8	23	-6	27	-7
MEDIAN																								
Existing	128	0	99	0	120	0	98	0	155	0	185	0	150	0	297	0	209	0	229	0	195	0	130	0
Future	89	-39	77	-22	85	-35	147	49	152	-3	216	31	194	44	112	-185	165	-44	168	-61	141	-54	101	-29
Future cumulative	89	-39	77	-22	88	-32	133	35	154	-1	216	31	194	44	112	-185	164	-45	167	-62	145	-50	101	-29
AVERAGE																								
Existing	124	0	133	0	207	0	233	0	222	0	238	0	190	0	311	0	242	0	225	0	177	0	119	0
Future	94	-30	102	-31	170	-37	235	2	217	-5	249	11	205	15	184	-127	196	-46	178	-47	145	-32	100	-19
Future cumulative	95	-29	105	-28	172	-35	233	0	220	-2	249	11	204	14	184	-127	197	-45	177	-48	140	-37	105	-14
MAXIMUM																								
Existing	301	0	853	0	1110	0	1279	0	795	0	930	0	523	0	910	0	635	0	361	0	281	0	184	0
Future	198	-103	735	-118	1036	-74	1271	-8	729	-66	870	-60	587	64	690	-220	576	-59	463	102	331	50	134	-50
Future cumulative	187	-114	737	-116	1037	-73	1271	-8	720	-75	870	-60	587	64	690	-220	576	-59	468	107	359	78	155	-29

Table 27. **Monthly Flow Statistics for the Trinity River at Lewiston under Existing, Future, and Future Cumulative Conditions**

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
Demand Conditions	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF	Flow TAF	Change TAF
MINIMUM																								
Existing	14	0	14	0	9	0	9	0	9	0	9	0	9	0	9	0	15	0	16	0	15	0	12	0
Future	14	0	14	0	9	0	9	0	9	0	9	0	9	0	9	0	15	0	16	0	15	0	12	0
Future cumulative	14	0	14	0	9	0	9	0	9	0	9	0	9	0	9	0	15	0	16	0	15	0	12	0
MEDIAN																								
Existing	18	0	18	0	18	0	18	0	16	0	28	0	36	0	55	0	46	0	40	0	28	0	18	0
Future	18	0	18	0	18	0	18	0	16	0	28	0	36	0	55	0	46	0	40	0	28	0	18	0
Future cumulative	18	0	18	0	18	0	18	0	17	1	28	0	36	0	55	0	46	0	40	0	28	0	18	0
AVERAGE																								
Existing	18	0	18	0	17	0	18	0	16	0	25	0	34	0	66	0	43	0	35	0	25	0	17	0
Future	18	0	18	0	17	0	18	0	16	0	25	0	33	-1	66	0	43	0	35	-1	25	0	17	0
Future cumulative	18	0	18	0	17	0	18	0	16	0	25	0	33	-1	66	0	43	0	35	0	25	0	17	0
MAXIMUM																								
Existing	18	0	18	0	18	0	97	0	17	0	48	0	114	0	348	0	137	0	40	0	28	0	18	0
Future	18	0	18	0	18	0	71	-26	17	0	48	0	112	-2	348	0	137	0	40	0	28	0	18	0
Future cumulative	18	0	18	0	18	0	66	-31	17	0	48	0	112	-2	348	0	137	0	40	0	28	0	18	0

Table 28. Monthly Flow Statistics for the Sacramento River at Keswick Dam under Existing, Future, and Future Cumulative Conditions

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change
Demand Conditions	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF
MINIMUM												
Existing	193	0	232	0	123	0	123	0	107	0	141	0
Future	180	-13	232	0	123	0	123	0	107	0	141	0
Future cumulative	180	-13	232	0	123	0	123	0	110	3	141	0
MEDIAN												
Existing	322	0	325	0	333	0	230	0	263	0	320	0
Future	343	21	334	9	322	-11	186	-44	263	0	300	-20
Future cumulative	351	29	325	0	307	-26	216	-14	255	-8	307	-13
AVERAGE												
Existing	366	0	381	0	470	0	527	0	512	0	508	0
Future	371	5	378	-3	438	-32	515	-12	497	-16	501	-7
Future cumulative	393	27	375	-6	428	-42	517	-10	497	-15	506	-2
MAXIMUM												
Existing	703	0	1823	0	1411	0	3226	0	1808	0	2753	0
Future	709	6	1364	-459	1407	-4	3226	0	1808	0	2753	0
Future cumulative	711	8	1337	-486	1407	-4	3226	0	1873	65	2753	0

	APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change	Flow	Change
Demand Conditions	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF	TAF
MINIMUM												
Existing	137	0	141	0	408	0	577	0	436	0	167	0
Future	137	0	141	0	379	-29	618	41	437	1	188	21
Future cumulative	137	0	141	0	379	-29	600	23	437	1	188	21
MEDIAN												
Existing	398	0	519	0	670	0	932	0	707	0	355	0
Future	423	25	507	-12	668	-2	901	-31	844	137	381	26
Future cumulative	403	5	507	-12	668	-2	894	-38	754	47	417	62
AVERAGE												
Existing	461	0	559	0	648	0	908	0	743	0	360	0
Future	453	-8	557	-2	656	8	895	-13	793	50	395	35
Future cumulative	451	-10	555	-4	658	10	881	-27	751	8	450	90
MAXIMUM												
Existing	1778	0	1060	0	853	0	1113	0	995	0	671	0
Future	1778	0	1060	0	976	123	1215	102	1053	58	646	-25
Future cumulative	1778	0	1060	0	976	123	1137	24	1031	36	673	2

Table 29. **Monthly Flow Statistics for the Sacramento River at Sacramento under Existing, Future, and Future Cumulative Conditions**

Demand Conditions	OCTOBER Flow TAF	OCTOBER Change TAF	NOVEMBER Flow TAF	NOVEMBER Change TAF	DECEMBER Flow TAF	DECEMBER Change TAF	JANUARY Flow TAF	JANUARY Change TAF	FEBRUARY Flow TAF	FEBRUARY Change TAF	MARCH Flow TAF	MARCH Change TAF
MINIMUM												
Existing	285	0	518	0	606	0	588	0	503	0	445	0
Future	335	50	483	-35	573	-33	601	13	547	44	374	-71
Future cumulative	326	41	511	-7	572	-34	580	-8	459	-44	371	-74
MEDIAN												
Existing	784	0	905	0	973	0	1141	0	1574	0	1367	0
Future	657	-127	873	-32	970	-3	1180	39	1600	26	1414	47
Future cumulative	738	-46	985	80	1049	76	1213	72	1521	-53	1498	131
AVERAGE												
Existing	822	0	1032	0	1455	0	1821	0	1908	0	1882	0
Future	728	-94	912	-121	1284	-171	1749	-72	1838	-70	1875	-7
Future cumulative	834	12	1069	37	1366	-89	1818	-3	1885	-23	1919	37
MAXIMUM												
Existing	1584	0	3333	0	4234	0	5678	0	4714	0	5664	0
Future	1393	-191	2071	-1262	3734	-500	5573	-105	4093	-621	5517	-147
Future cumulative	1532	-52	2830	-503	3746	-488	5573	-105	4239	-475	5517	-147

Demand Conditions	APRIL Flow TAF	APRIL Change TAF	MAY Flow TAF	MAY Change TAF	JUNE Flow TAF	JUNE Change TAF	JULY Flow TAF	JULY Change TAF	AUGUST Flow TAF	AUGUST Change TAF	SEPTEMBER Flow TAF	SEPTEMBER Change TAF
MINIMUM												
Existing	410	0	508	0	462	0	504	0	370	0	334	0
Future	355	-55	480	-28	434	-28	479	-25	383	13	387	53
Future cumulative	354	-56	480	-28	428	-34	491	-13	398	28	387	53
MEDIAN												
Existing	1096	0	1062	0	906	0	1120	0	858	0	606	0
Future	1035	-61	975	-87	911	5	1140	20	974	116	802	196
Future cumulative	1139	43	971	-91	853	-53	879	-241	821	-37	700	94
AVERAGE												
Existing	1408	0	1373	0	1027	0	1058	0	846	0	617	0
Future	1365	-43	1262	-111	1008	-19	1103	45	943	97	738	121
Future cumulative	1402	-6	1232	-141	956	-71	865	-193	792	-54	697	80
MAXIMUM												
Existing	4163	0	4030	0	2435	0	1339	0	1177	0	1052	0
Future	4146	-17	3797	-233	2325	-110	1319	-20	1278	101	998	-54
Future cumulative	4146	-17	3797	-233	2325	-110	1138	-201	1004	-173	1015	-37

Section B-2. DWR Planning Simulation (DWRSIM) Assumptions for Los Vaqueros Project Studies

DWR PLANNING SIMULATION MODEL (DWRSIM) ASSUMPTIONS FOR LOS VAQUEROS STUDIES

1. Operations Study A7e

- DWR's 1990 level hydrology and upstream depletions, for the study period for October 1921 through September 1978.

- No North Delta or South Delta channel improvements.

- Sherman Island Overland facility is assumed to be in operation, satisfying the water quality requirements specified in the DWR contract with the North Delta Water Agency.

- Minimum Delta outflow requirements to meet SWRCB D-1485 standards, assuming the interim Suisun Marsh criteria.

- Carriage water requirements based on D-1485 agriculture standards at Jersey Point and allowable export/salinity repulsion curves for Rock Slough. The export/salinity repulsion curves are designed to maintain a water quality of 130 mg/l chloride during winter and spring months and 225 mg/l chloride during summer and fall months at Rock Slough, as per D-1485. These values are used to provide an operational buffer.

- SWP Banks Pumping Plant average monthly capacity with existing pumps is assumed to be 6,240 cfs. Pumping is also limited to 3,000 cfs in May and June, and 4,600 cfs in July to comply with D-1485 criteria for striped bass survival. Additionally, SWP pumping is limited to 2,000 cfs in May and/or June when storage withdrawals from Lake Oroville occur (January 5, 1987 Interim Agreement between DWR and DFG).

- CVP Tracy Pumping Plant capacity is 4,600 cfs, but constraints along the Delta-Mendota Canal can limit export capacity. Pumping is also limited to 3,000 cfs in May and June in accordance with D-1485 criteria for striped bass survival.

- Wheeling of CVP water through SWP facilities to San Luis Reservoir is permitted only when unused SWP Banks Pumping Plant capability is available. Annually, the amount of CVP water wheeled is limited to the sum of (1) what is needed to offset the CVP Tracy Pumping Plant's compliance with the D-1485 criteria; and (2) the amount needed to meet the 128 TAF/year CVP Cross Valley Canal demand.

- CVP/SWP sharing of responsibility for the coordinated operation of the two projects is maintained per the Coordinated Operations Agreement, with storage withdrawals for in-basin use split 75 percent CVP/25 percent SWP and unstored flow for export split 55 percent CVP and 45 percent SWP.

- Trinity River minimum fish flows below Lewiston Dam are 340/220/140 TAF per year using the Shasta criteria, per the recent 1981 agreement with the USFWS.

- Sacramento River minimum fish flows below Keswick Dam reflect the criteria specified in the USBR agreement with DFG (as modified by letter agreement of October 8, 1981). This flow ranges between 2,300 to 3,900 cfs per Shasta criteria and depends on the time of the year.

- Sacramento River navigation flows are maintained at 4,000 cfs (April-October) or 3,000 cfs (November-March) at Wilkins Slough. Flows are modified/reduced in critical water years.

- Feather River fishery flows are maintained per the agreement between DWR and the DFG (August 26, 1983). In normal years these minimum flows are 1,700 cfs from October through March and 1,000 cfs from April through September, with lower minimum flows allowed in dry/critical years.

- American River minimum fish and recreation flows are maintained per USBR operations criteria (1,500 to 2,000 cfs) as long as sufficient storage is available in Folsom Reservoir. In dry and critical years, minimum flows may be reduced to SWRCB D-893 requirements (250 to 500 cfs) in order to maintain minimum storage levels in Folsom Reservoir.

- The San Joaquin River water quality standards at Vernalis are maintained as described below.

  - In April 1973 the State Water Resources Control Board issued the "New Melones Project Water Rights Decision", D-1422. This decision requires an annual New Melones release of up to 98,000 acre-feet for the maintenance of fish and wildlife. In addition, the decision has a provision requiring additional releases of up to 70,000 acre-feet per year to maintain 500 ppm total dissolved solids at Vernalis year-round.

  - The first agreement is the October 1986 interim agreement between the South Delta Water Agency, the U.S. Bureau of Reclamation, and the California Department of Water Resources. The provisions of this agreement which are modeled are as follows:

    1. Flows of the San Joaquin River at Vernalis will be maintained at not less than 500 cfs.

    2. The salinity of the San Joaquin River at Vernalis will be maintained at 450 ppm TDS or better for the irrigation season (April-October) and 500 ppm TDS or better for the remainder of the year (November-March).

    3. Flows of the San Joaquin River at Vernalis will be maintained at not less than the following monthly volumes (TAF/month):

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
37	31	30	30	30	30	35	44	49	69	64	45

4. The releases from New Melones required to meet the above criteria are limited to a maximum of 150,000 acre-feet per water year in addition to the releases made to maintain fish and water quality in accordance with D-1422.

- The second agreement is the June 1987 agreement between the California Department of Fish and Game and the U.S. Bureau of Reclamation which sets interim instream fish flows on the Stanislaus River below New Melones Reservoir. This agreement provides for a minimum annual Stanislaus River fish flow at 98,300 acre-feet and a maximum of 302,100 acre-feet. The actual required fish flow for any given year is based upon the available water supply for that year.

o 1990-level CVP annual demands in TAF/Year are as follows:

	Critical Year	Non-Critical Year
Contra Costa Canal	131	118
DMC and Exchange	1,609	1,609
CVP San Luis Unit	1,331	1,331
Cross Valley Canal	128	128
San Luis Interim Deliveries	140	140
San Felipe Unit	104	104
Total CVP Delta Exports	3,443	3,430
Folsom South Canal	65	65
Other American River Demands	288	288

o Additional CCWD net demand from the San Joaquin River of 29.75 TAF in non-critical years and 18.77 TAF in critical years.

o CVP agricultural deficiencies are imposed as follows: 25 percent in years 1924, 1931, 1932, 1933, and 1934; and 50 percent in 1977.

o 1990-level SWP annual export demands (TAF/year) are developed from the State Water Project Analysis Office's long-range projections from DWR Bulletin 132-88, as tabulated below:

	Entitlement Request	Scheduled Surplus
North Bay Aqueduct	27	0
South Bay Aqueduct	186	2
SWP Dos Amigos demand	2,954	219
Total Demands	3,167	221
Agricultural portion	1,241	221
M&I portion	1,857	0
Recreation and losses	69	0

2. <u>Operations Study 543b</u>

- DWR's 2000 level hydrology and upstream depletion, based on DWR Bulletin 160-74 projections (57 years: 1922 - 1978).

- No North Delta or South Delta channel improvements.

- Sherman Island Overland Facility in operation, thus satisfying the water quality requirements specified in the DWR contract with the North Delta Water Agency.

- Minimum Delta outflow requirements maintained to satisfy D-1485, assuming the Interim Suisun Marsh criteria.

- Carriage water requirements based on D-1485 agriculture standards at Jersey Point and allowable export/salinity repulsion curves for Rock Slough. The export/salinity repulsion curves are designed to maintain a water quality of 130 mg/l chloride during winter and spring months and 225 mg/l chloride during summer and fall months at Rock Slough, as per D-1485. These values are used to provide an operational buffer.

- SWP Banks Pumping Plant average monthly capacity with 4 new pumps is set at 6,680 cfs (or 7,300 cfs in some winter months) in accordance with the USCE permit criteria. Pumping is limited to 3,000 cfs in May and June, and 4,600 cfs in July to comply with D-1485 criteria for striped bass survival. Additionally SWP pumping is limited to 2,000 cfs in any May or June in which storage withdrawals from Oroville Reservoir are required (per the January 5, 1987 Interim Agreement between DWR and the California Department of Fish and Game).

- CVP Tracy Pumping Plant capacity is 4,600 cfs, but constraints along the Delta Mendota Canal and at the relift pumps (to O'Neil Forebay) restrict capacity to 4,200 cfs at that point. Pumping also limited to 3,000 cfs in May and June in accordance with D-1485 criteria for striped bass survival.

- Wheeling of CVP water through SWP facilities to San Luis Reservoir only when unused SWP Banks Pumping Plant capacity is available. Annually, the amount of CVP water wheeled is limited to what is needed to offset the CVP Tracy Pumping Plant's compliance with D-1485 criteria.

- CVP/SWP sharing of responsibility for the coordinated operation of the two projects maintained per the Coordinated Operation Agreement; with storage withdrawals for in-basin use split 75 percent CVP/25 percent SWP, and unstored flow for storage and export split 55 percent CVP/45 percent SWP.

- San Luis Joint Reach canal (check 12) enlarged by 1,000 cfs, to a capacity of 8,100 cfs at its smallest reach.

- East Branch of the California Aqueduct is enlarged by 1,500 cfs, to a final capacity of 3,149 cfs, downstream of Alamo Power Plant, and 2,811 cfs at Devil Canyon Power Plant. The Santa Ana Pipeline to Lake Perris has been enlarged to 730 cfs capacity to supply the demands of Reaches 28G through 28J.

- Trinity river minimum fish flows maintained at 340, 220 or 140 TAF/year using the Shasta criteria, per recent agreement between the USBR and the U.S. Fish and Wildlife Service.

- Sacramento River fishery flows below Keswick Dam maintained per the agreement between U.S. Bureau of Reclamation and California Department of Fish and Game (revised October 81), ranging from 2600 to 3900 cfs depending on the time of year.

- Sacramento River navigation control point (NCP) flows maintained at 4,000 cfs (April - October) or 3,000 cfs (November-March) at Wilkins Slough, in accordance with the original legislation that authorized the CVP in 1935 and 1937. Flows would be reduced in critical water years.

- Feather River fishery flows maintained per the agreement between DWR and the California Department of Fish and Game (August 26, 1983). In normal years these minimum flows are 1700 cfs from October through March and 1000 cfs from April through September, with lower minimum flows allowed in dry/critical water years.

- Oroville flood control storage based on the 1989 USCE revised diagram.

- American river minimum fish and recreation flows based on the storage in Folsom Lake per USBR operation criteria, as follows:

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP
CFS MIN	2000	1500	1500	1500	1500	1500	1500	2000	2000	2000	2000	2000
W/STO >	600	600	600	650	710	760	850	900	900	800	700	650
CFS MIN	1375	1250	1250	1250	1250	1250	1250	1375	1500	1500	1500	1500
W/STO >	400	400	400	400	550	600	650	750	700	610	500	400
CFS MIN	1000	1000	1000	1000	1000	1000	1000	1375	1500	1500	1500	1250
W/STO >	300	250	250	350	520	570	600	570	500	400	350	300
CFS MIN	500	500	500	500	500	500	500	500	500	500	500	500
W/STO >	200	200	200	220	300	380	400	350	300	300	250	200
CFS MIN	500	500	500	250	250	250	250	250	250	250	250	375
W/STO >	90	90	90	90	90	90	90	90	90	90	90	90

- Stanislaus River minimum fish flows below New Melones Reservoir are set at 98 TAF/year per earlier agreements between California Department of Fish and Game and U.S. Bureau of Reclamation.

- San Joaquin River water quality standards at Vernalis are maintained per SWRCB Decision 1422 by making New Melones Reservoir releases when necessary. An older flow/salinity relationship developed in 1982 was used to calculate the amount of New Melones releases necessary to blend with the San Joaquin River water to maintain the 500 ppm TDS standard.

- 2000 level CVP demands as follows:

		Critical Year	Non-Critical Year	
Contra Costa Canal	-	188	175	TAF/Year
DMC and Exchange	-	1,637	1,637	
CVP San Luis Unit	-	1,320	1,320	
San Luis Interim deliveries	-	60	60	
San Felipe Unit	-	173	173	
Total CVP Delta Exports	-	3,378	3,365	TAF/Year
Folsom South Canal	-	312	312	TAF/Year

- 25% deficiency imposed on Contra Costa Canal demand, March 1977-February 1978.

- Additional CCWD net demand from San Joaquin River of 29.75 TAF in non-critical years and 18.77 TAF in critical years.

- CVP agricultural deficiencies imposed as follows: 25 percent in years 1924, 1929, 1931, 1933, 1934, 1976, and 50 percent in 1977.

- SWP demands based on SWPAO's long-range projections for DWR Bulletin 132-90, as tabulated below.

	Entitlement Request (2000 level)	
No. Bay Aqueduct	53	TAF/Year
So. Bay Aqueduct	213	
SWP Dos Amigos demand	3,516	
Total Demands	3,782	TAF/Year
Agricultural portion	1,249	
M&I Portion	2,469	
Recreation & Losses	64	

- Actual SWP deliveries were based on a risk curve which is defined by the following relationship:

Carry-over Storage (TAF)	SWP Annual Delivery (TAF)
72	0
500	500
1,000	500
1,000	1,000
1,050	1,500
1,100	1,750
1,200	2,000
1,350	2,300
2,000	3,275
2,150	3,524
2,327	4,300

3. Operations Study 473b

- DWR's 2000 level hydrology and upstream depletion, based on DWR Bulletin 160-74 projections (57 years: 1922 - 1978).

- No North Delta or South Delta channel improvements.

- Sherman Island Overland Facility in operation, thus satisfying the water quality requirements specified in the DWR contract with the North Delta Water Agency.

- Minimum Delta outflow requirements maintained to satisfy D-1485, assuming the Interim Suisun Marsh criteria.

- Carriage water requirements based on D-1485 agriculture standards at Jersey Point and allowable export/salinity repulsion curves for Rock Slough. The export/salinity repulsion curves are designed to maintain a water quality of 130 mg/l chloride during winter and spring months and 225 mg/l chloride during summer and fall months at Rock Slough, as per D-1485. These values are used to provide an operational buffer.

- SWP Banks Pumping Plant average monthly capacity with 4 new pumps is set at 6,680 cfs (or 7,300 cfs in some winter months) in accordance with the USCE permit criteria. Pumping is limited to 3,000 cfs in May and June, and 4,600 cfs in July to comply with D-1485 criteria for striped bass survival. Additionally SWP pumping is limited to 2,000 cfs in any May or June in which storage withdrawals from Oroville Reservoir are required (per the January 5, 1987 Interim Agreement between DWR and the California Department of Fish and Game).

- CVP Tracy Pumping Plant capacity is 4,600 cfs, but constraints along the Delta Mendota Canal and at the relift pumps (to O'Neil Forebay) restrict capacity to 4,200 cfs at that point. Pumping also limited to 3,000 cfs in May and June in accordance with D-1485 criteria for striped bass survival.

- Wheeling of CVP water through SWP facilities to San Luis Reservoir only when unused SWP Banks Pumping Plant capacity is available. Annually, the amount of CVP water wheeled is limited to what is needed to offset the CVP Tracy Pumping Plant's compliance with D-1485 criteria.

- CVP/SWP sharing of responsibility for the coordinated operation of the two projects maintained per the Coordinated Operation Agreement; with storage withdrawals for in-basin use split 75 percent CVP/25 percent SWP, and unstored flow for storage and export split 55 percent CVP/45 percent SWP.

- San Luis Joint Reach canal (check 12) enlarged by 1,000 cfs, to a capacity of 8,100 cfs at its smallest reach.

- East Branch of the California Aqueduct is enlarged by 1,500 cfs, to a final capacity of 3,149 cfs, downstream of Alamo Power Plant, and 2,811 cfs at Devil Canyon Power Plant. The Santa Ana Pipeline to Lake Perris has been enlarged to 730 cfs capacity to supply the demands of Reaches 28G through 28J.

- Trinity river minimum fish flows maintained at 340, 220 or 140 TAF/year using the Shasta criteria, per recent agreement between the USBR and the U.S. Fish and Wildlife Service.

- Sacramento River fishery flows below Keswick Dam maintained per the agreement between U.S. Bureau of Reclamation and California Department of Fish and Game (revised October 81), ranging from 2600 to 3900 cfs depending on the time of year.

- Sacramento River navigation control point (NCP) flows maintained at 4,000 cfs (April - October) or 3,000 cfs (November-March) at Wilkins Slough, in accordance with the original legislation that authorized the CVP in 1935 and 1937. Flows would be reduced in critical water years.

- Feather River fishery flows maintained per the agreement between DWR and the California Department of Fish and Game (August 26, 1983). In normal years these minimum flows are 1700 cfs from October through March and 1000 cfs from April through September, with lower minimum flows allowed in dry/critical water years.

- Oroville flood control storage based on the 1989 USCE revised diagram.

- American river minimum fish and recreation flows based on the storage in Folsom Lake per USBR operation criteria, as follows:

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP
CFS MIN	2000	1500	1500	1500	1500	1500	1500	2000	2000	2000	2000	2000
W/STO >	600	600	600	650	710	760	850	900	900	800	700	650
CFS MIN	1375	1250	1250	1250	1250	1250	1250	1375	1500	1500	1500	1500
W/STO >	400	400	400	400	550	600	650	750	700	610	500	400
CFS MIN	1000	1000	1000	1000	1000	1000	1000	1375	1500	1500	1500	1250
W/STO >	300	250	250	350	520	570	600	570	500	400	350	300
CFS MIN	500	500	500	500	500	500	500	500	500	500	500	500
W/STO >	200	200	200	220	300	380	400	350	300	300	250	200
CFS MIN	500	500	500	250	250	250	250	250	250	250	250	375
W/STO >	90	90	90	90	90	90	90	90	90	90	90	90

- Stanislaus River minimum fish flows below New Melones Reservoir are set at 98 TAF/year per earlier agreements between California Department of Fish and Game and U.S. Bureau of Reclamation.

- San Joaquin River water quality standards at Vernalis are maintained per SWRCB Decision 1422 by making New Melones Reservoir releases when necessary. An older flow/salinity relationship developed in 1982 was used to calculate the amount of New Melones releases necessary to blend with the San Joaquin River water to maintain the 500 ppm TDS standard.

- 2000 level CVP demands as follows:

		Critical Year	Non-Critical Year	
Contra Costa Canal	-	188	175	TAF/Year
DMC and Exchange	-	1,637	1,637	
CVP San Luis Unit	-	1,320	1,320	
San Luis Interim deliveries	-	60	60	
San Felipe Unit	-	173	173	
Total CVP Delta Exports	-	3,378	3,365	TAF/Year
Folsom South Canal	-	312	312	TAF/Year

- 25% deficiency imposed on Contra Costa Canal demand, March 1977 - February 1978.

- Additional CCWD net demand from San Joaquin River of 29.75 TAF in non-critical years and 18.77 TAF in critical years.

- CVP agricultural deficiencies imposed as follows: 25 percent in years 1924, 1929, 1931, 1933, 1934, 1976, and 50 percent in 1977.

- SWP demands based on SWPAO's long-range projections for DWR Bulletin 132-90, as tabulated below.

	Entitlement Request (2035 level)	
No. Bay Aqueduct	67	TAF/Year
So. Bay Aqueduct	213	
SWP Dos Amigos demand	3,944	
Total Demands	4,224	TAF/Year
Agricultural portion	1,255	
M&I Portion	2,905	
Recreation & Losses	64	

- Actual SWP deliveries were based on a risk curve which is defined by the following relationship:

Carry-over Storage (TAF)	SWP Annual Delivery (TAF)
72	0
500	500
1,000	500
1,000	1,000
1,050	1,500
1,100	1,750
1,200	2,000
1,350	2,300
2,000	3,275
2,150	3,524
2,327	4,300

4. Operations Study 476b

Study 476b assumptions are the same as those described for Study 473b, except for the changes described below.

- South Delta channel improvements are assumed to be completed, so that the maximum diversion capacity at the SWP Banks Pumping Plant is 10,300 cfs. Pumping is still limited to 3,000 cfs in May and June, and 4,600 cfs in July to comply with D-1485 criteria for striped bass survival. Additionally SWP pumping is limited to 2,000 cfs in any May or June in which storage withdrawals from Oroville Reservoir are required (per the January 5, 1987 Interim Agreement between DWR and the California Department of Fish & Game).

- North Delta channel improvements are assumed to be completed, eliminating the need for additional upstream releases to meet Delta carriage water requirements. However CVP operations are maintained per Study 473b, so that the SWP receives 100% of the project benefits.

- A 1.0 MAF capacity Kern Water Bank ground water project is assumed to be in operation, with maximum recharge and extraction rates set at 30 TAF/month.

- A 1.73 MAF Los Banos Grandes Reservoir is assumed to be in operation as an offstream storage facility of the SWP. Minimum storage pool is set at 50 TAF, and the capacity of the inlet/outlet pump-generating facility is assumed to be 3,500 cfs.

- SWP demands are based on SWPAO's long-range projections for DWR Bulletin 132-90, using the same year 2035 entitlement requests as tabulated above for Study 473b.

- Actual SWP deliveries were based on a risk curve defined by the following relationship:

EOM September Carry-over Storage (TAF)	SWP Annual Water Delivery (TAF)
72	0
500	500
1,000	500
1,000	1,000
1,050	1,500
1,100	1,750
1,200	2,000
1,350	2,300
1,157	2,550
2,750	3,275
2,900	3,524
3,077	4,300

Note that the total SWP reservoir carryover storage for 476b includes Oroville, SWP portion of San Luis, Kern Water Bank, and Los Baños Grandes storage.

Section B-3. Graphic Display of Salinity Changes Under the Los Vaqueros Project Alternatives

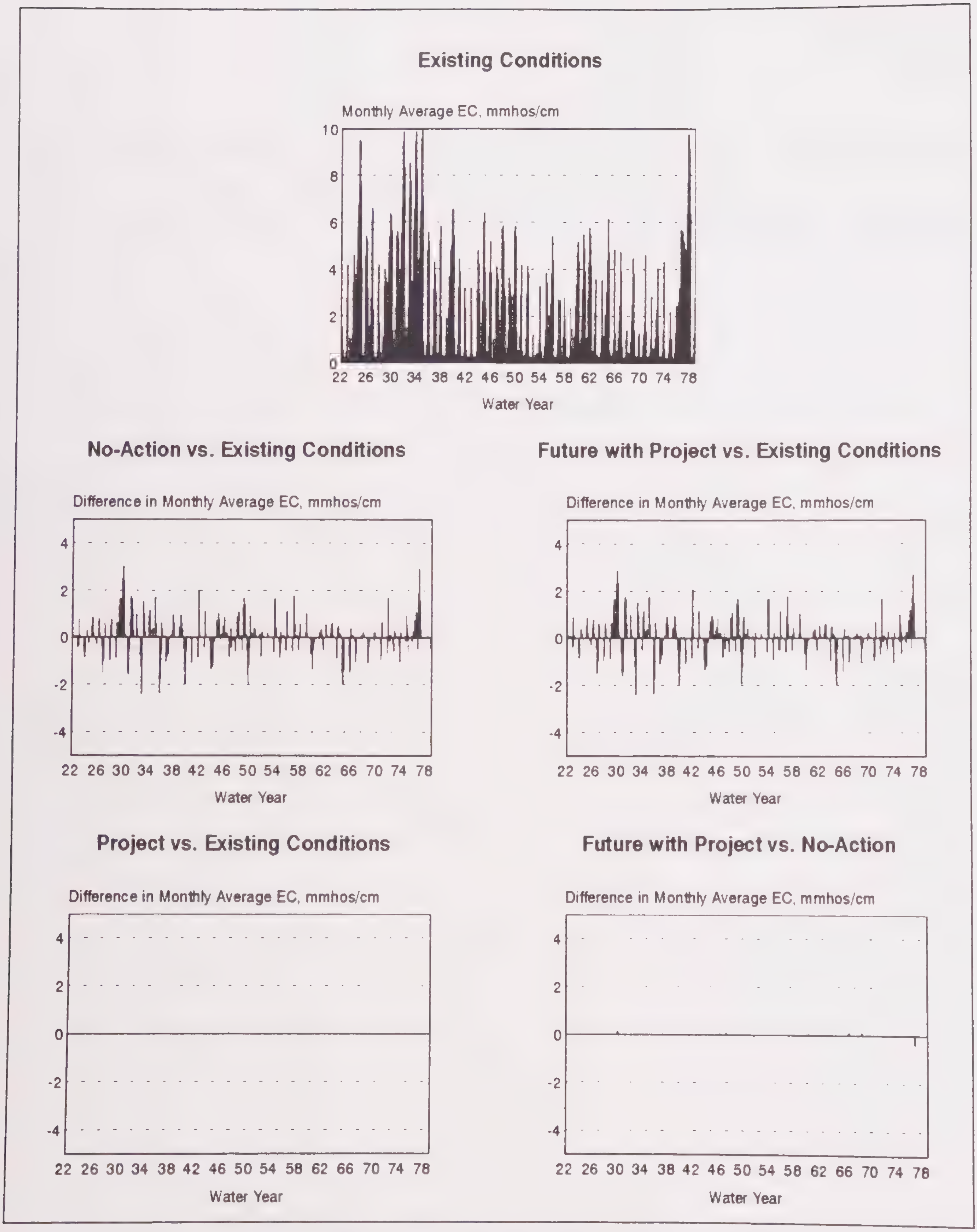

Figure 1. Estimated Salinity Impacts
San Joaquin River at Antioch
Rock Slough/Clifton Court Forebay Configuration

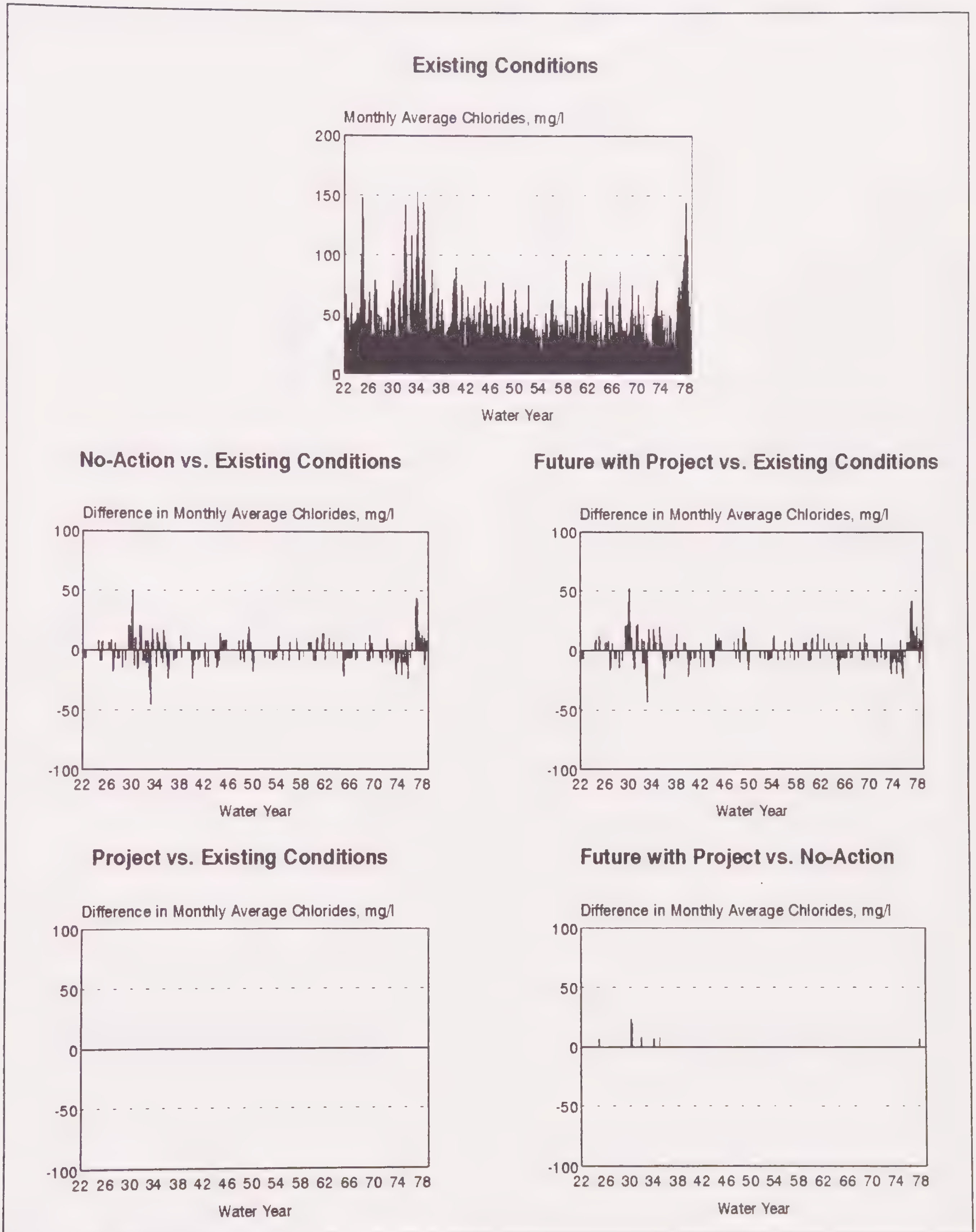

Figure 2. Estimated Salinity Impacts
Clifton Court Forebay
Rock Slough/Clifton Court Forebay Configuration

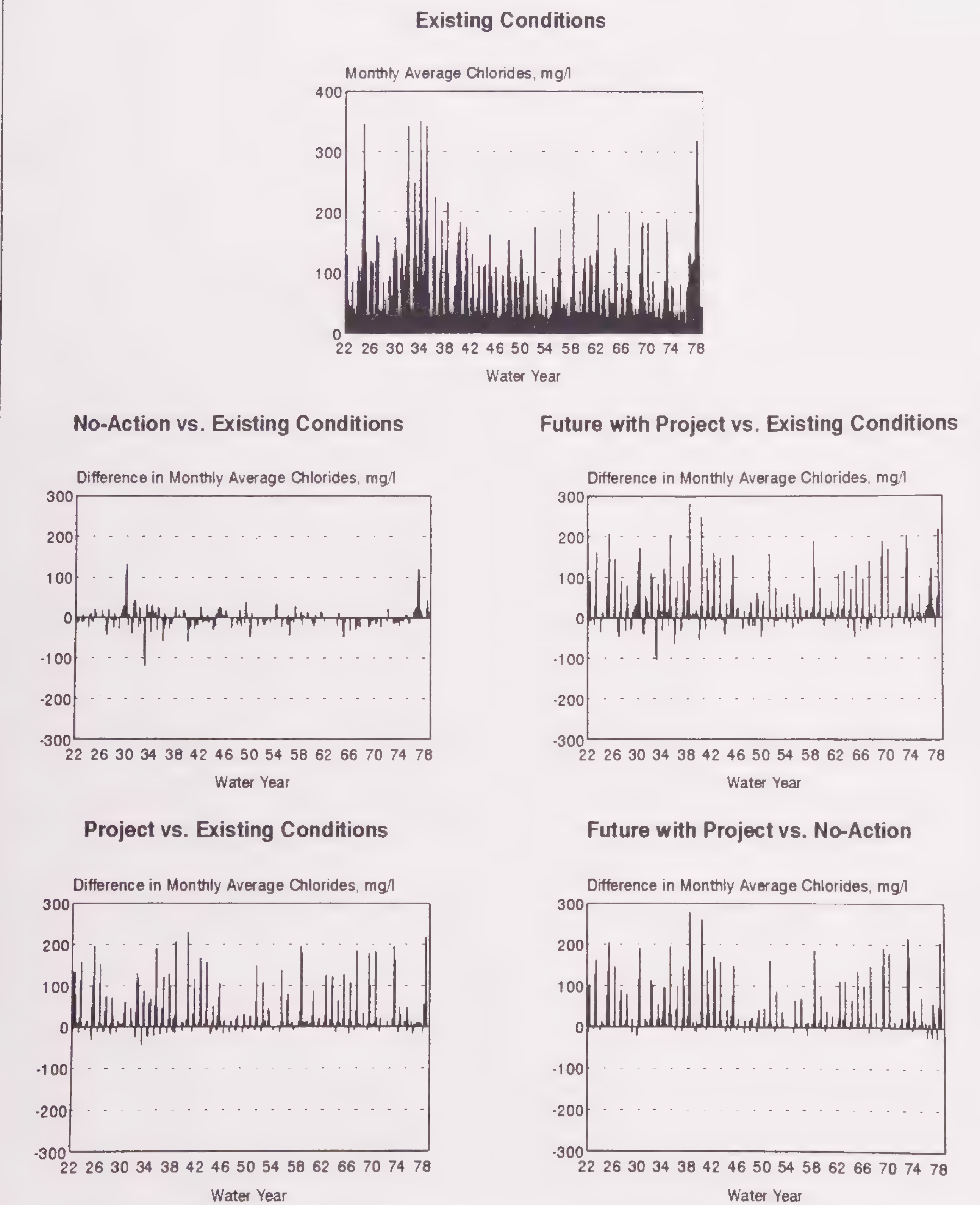

Figure 3. Estimated Salinity Impacts
Contra Costa Canal at Pumping Plant No. 1
Rock Slough/Clifton Court Forebay Configuration

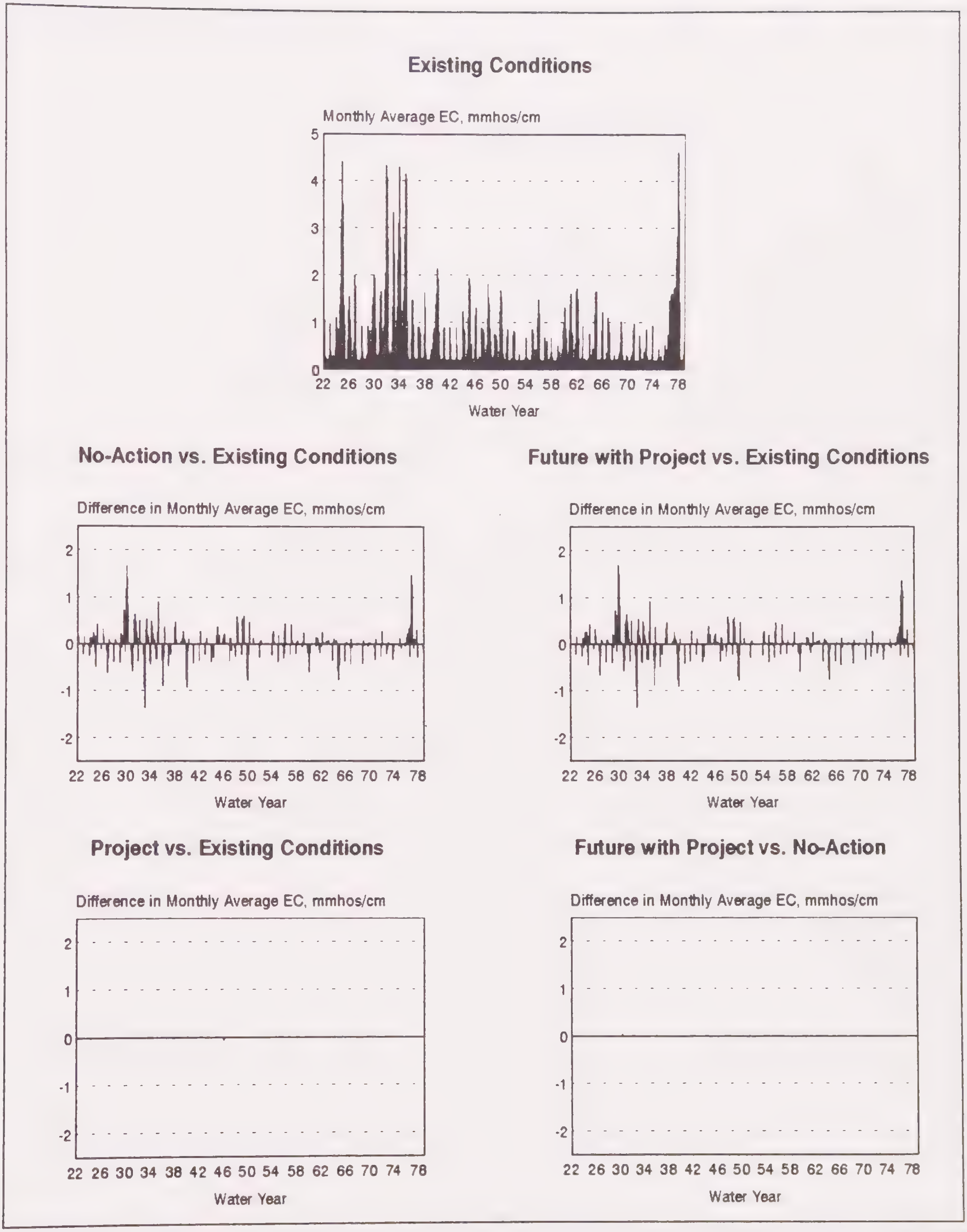

Figure 4. Estimated Salinity Impacts
Sacramento River at Emmaton
Rock Slough/Clifton Court Forebay Configuration

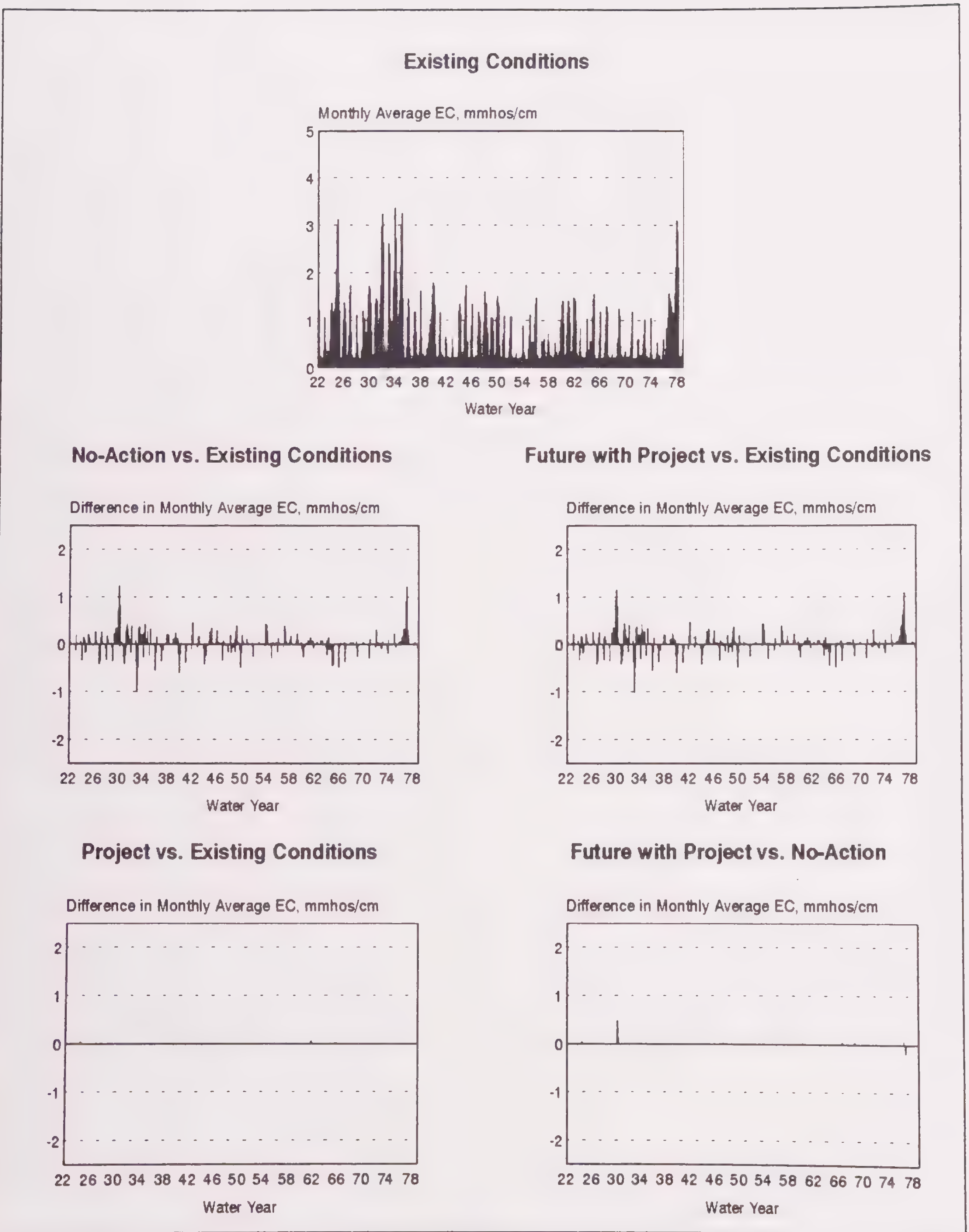

Figure 5. Estimated Salinity Impacts
San Joaquin River at Jersey Point
Rock Slough/Clifton Court Forebay Configuration

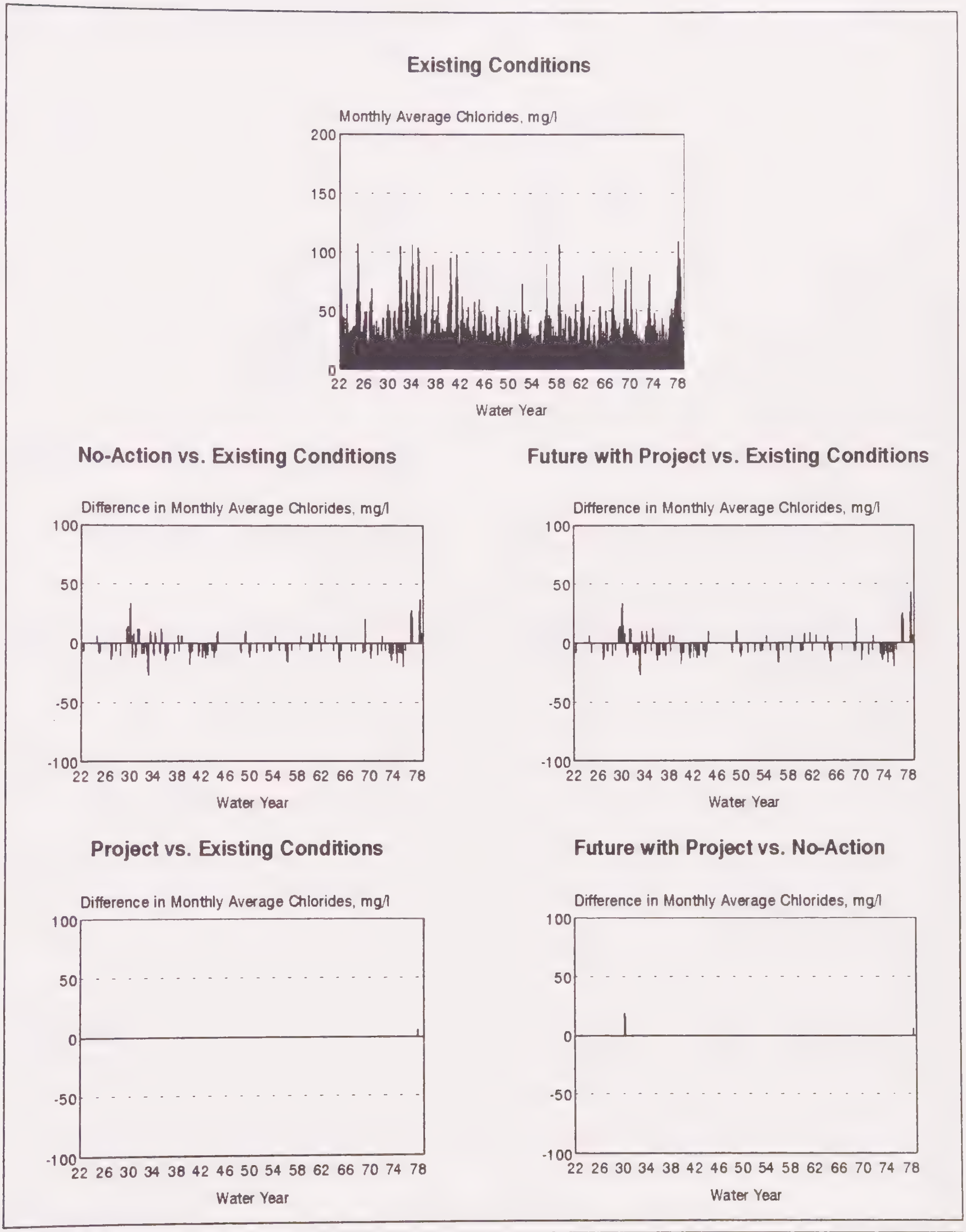

Figure 6: Estimated Salinity Impacts
Middle River at Woodward Island
Rock Slough/Clifton Court Forebay Configuration

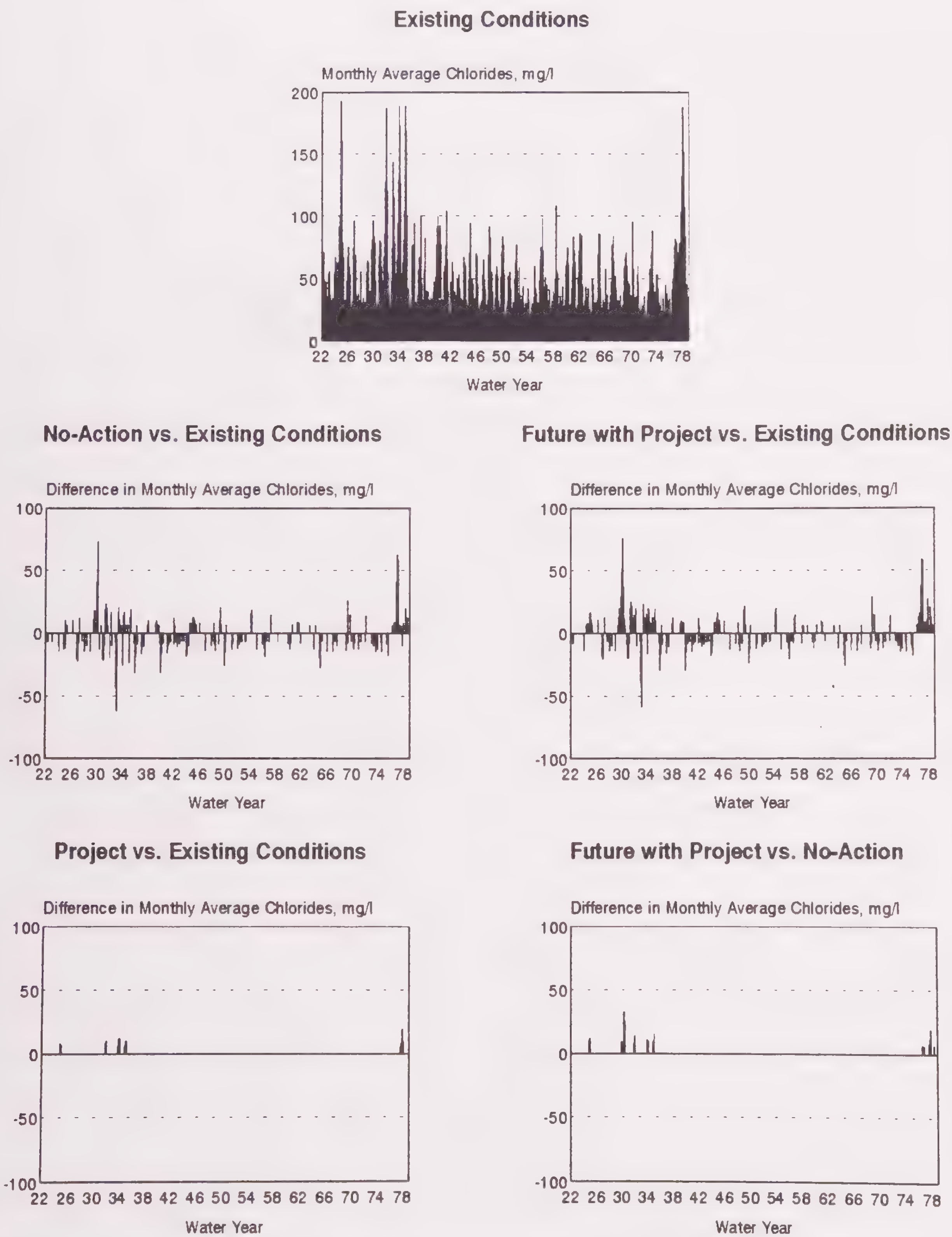

Figure 7. Estimated Salinity Impacts
Old River at Highway 4
Rock Slough/Clifton Court Forebay Configuration

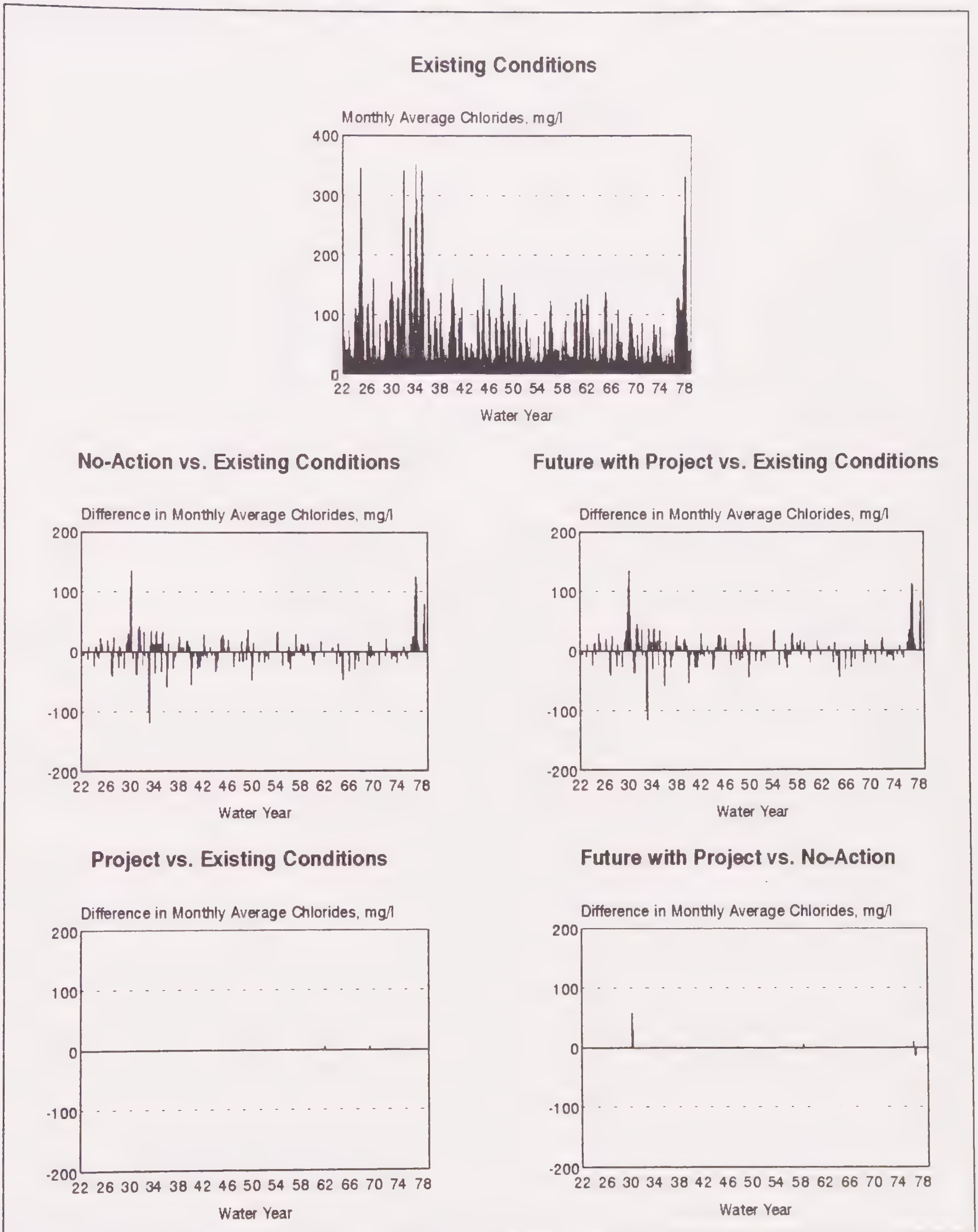

Figure 8. Estimated Salinity Impacts
Old River at Rock Slough
Rock Slough/Clifton Court Forebay Configuration

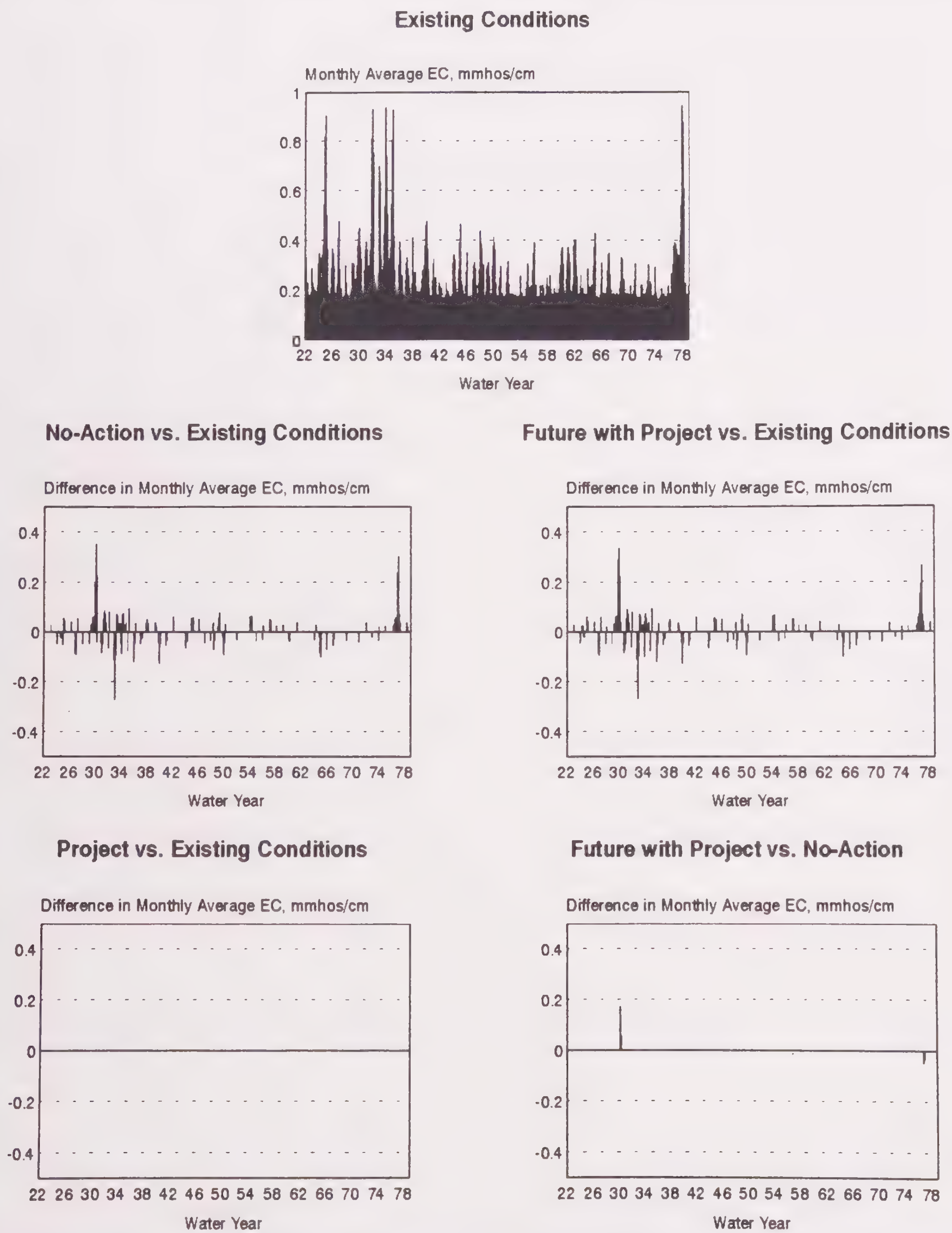

Figure 9. Estimated Salinity Impacts
San Andreas Landing
Rock Slough/Clifton Court Forebay Configuration

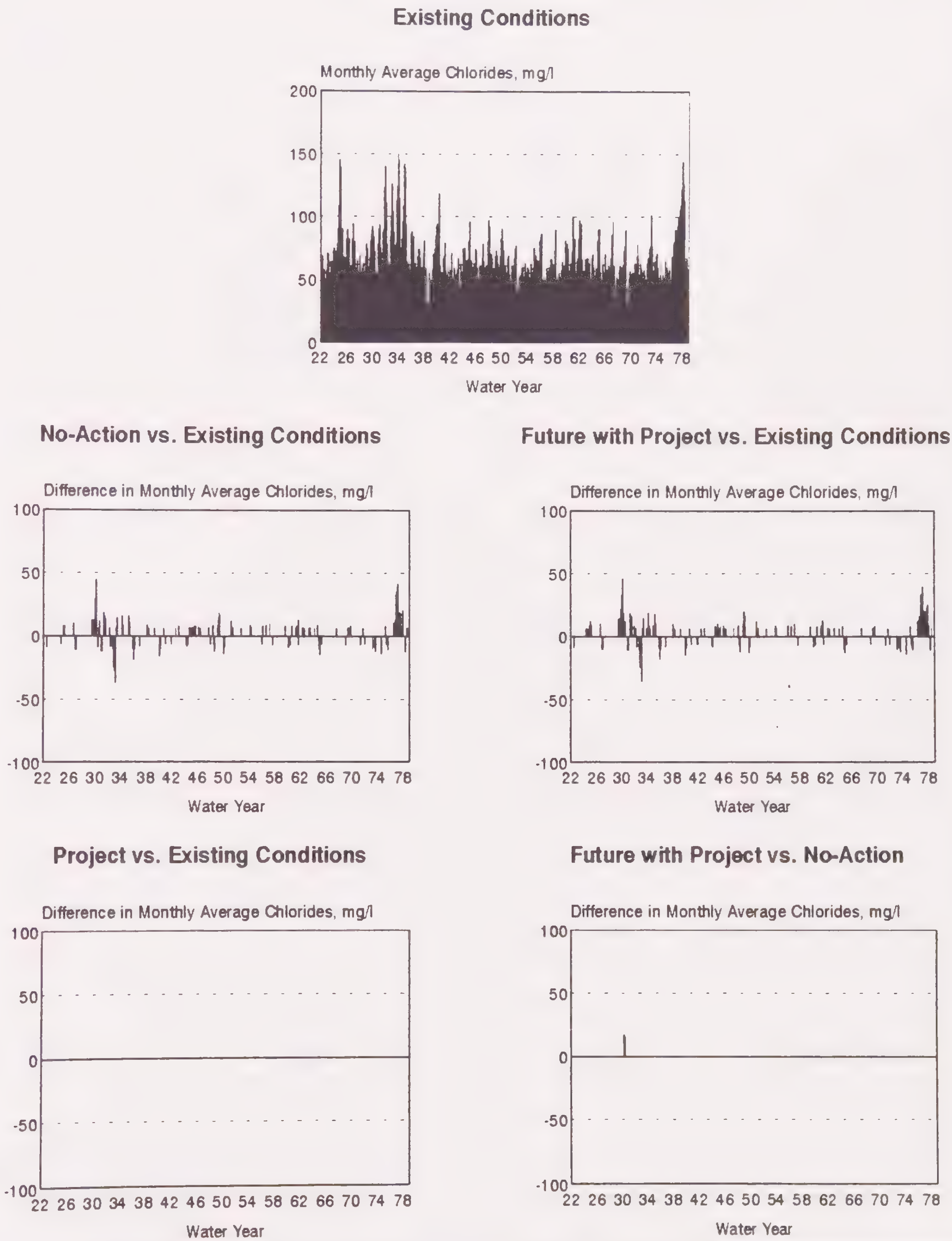

Figure 10. Estimated Salinity Impacts
Tracy Pumping Plant
Rock Slough/Clifton Court Forebay Configuration

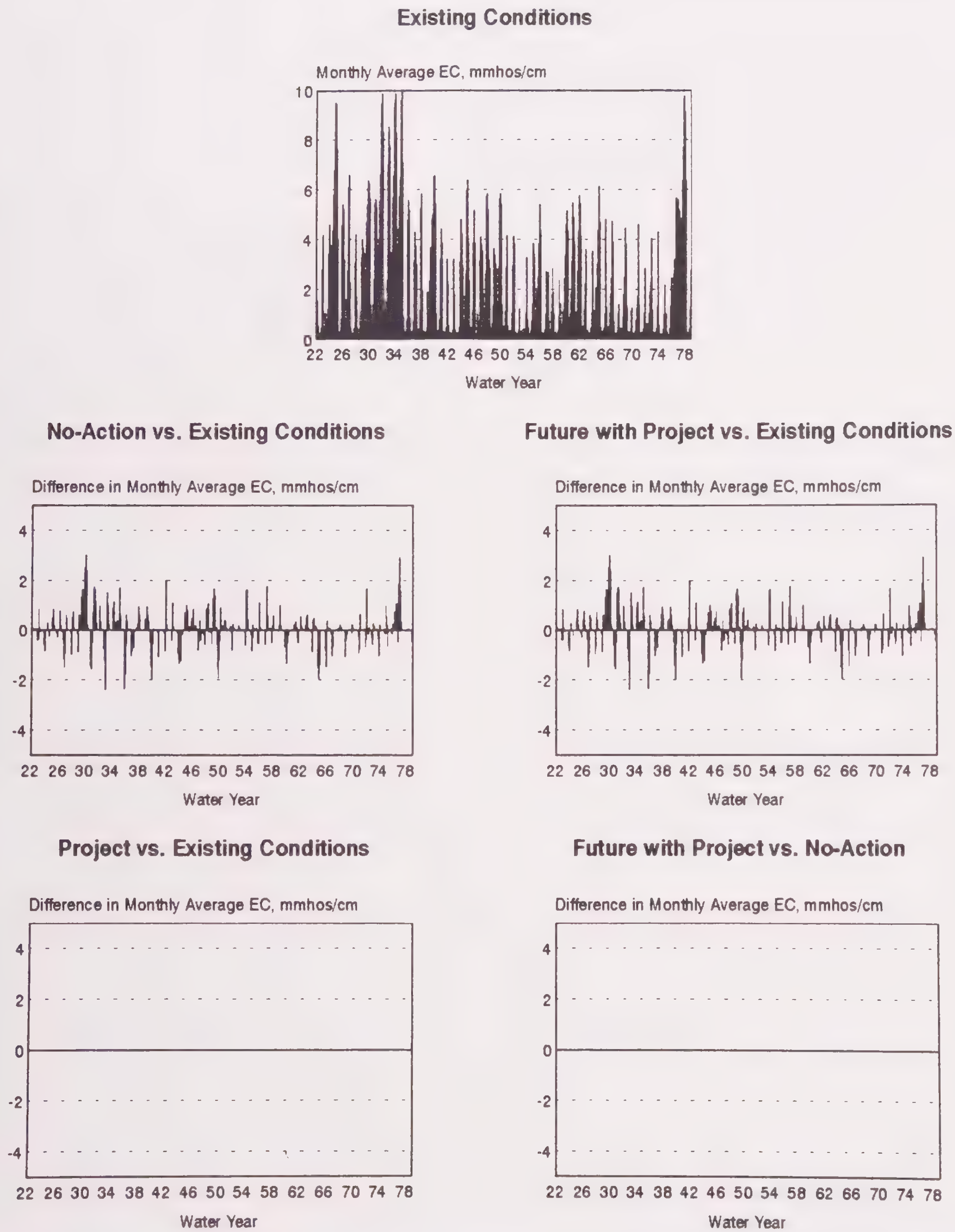

Figure 11. Estimated Salinity Impacts
San Joaquin River at Antioch
Middle River Alternative

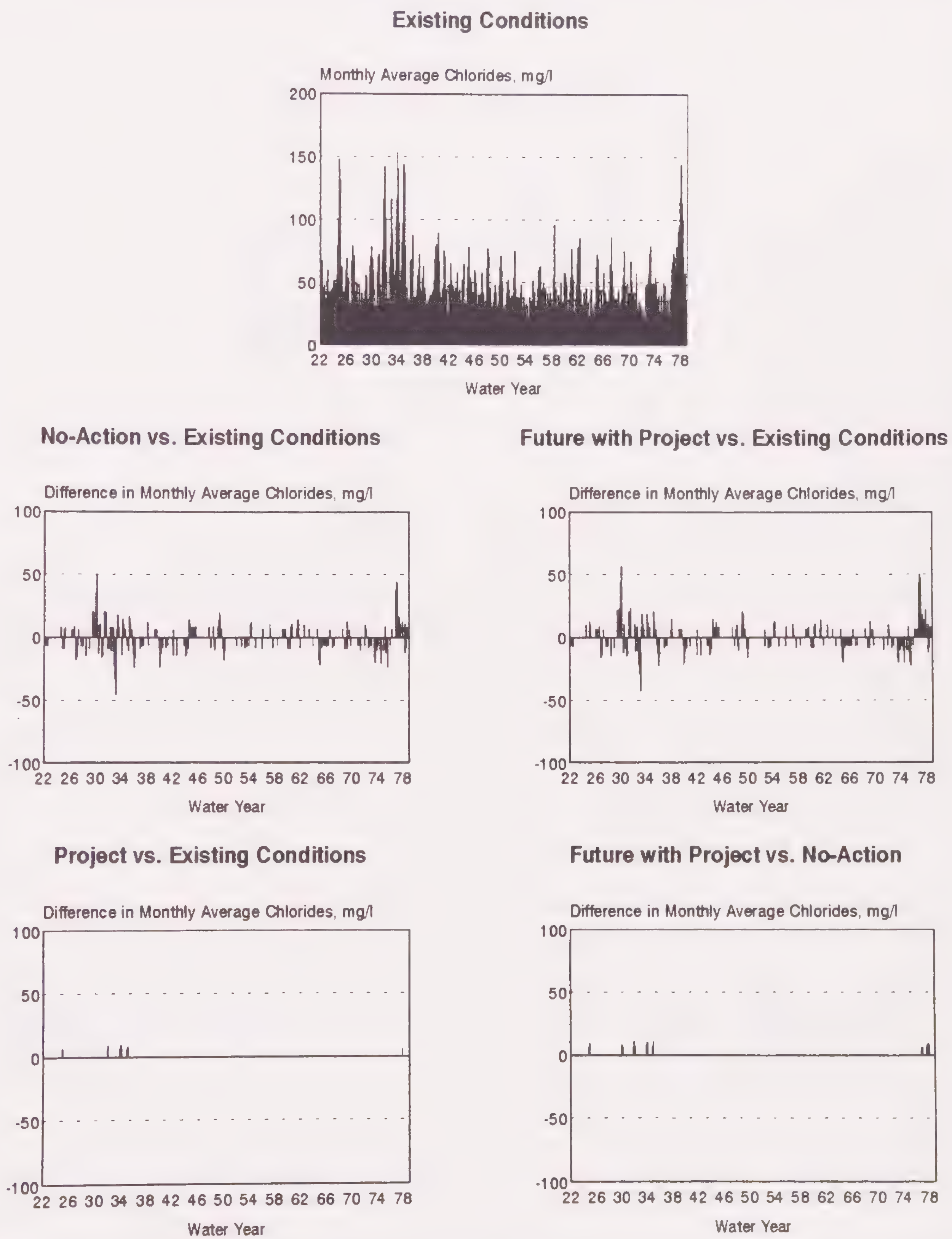

Figure 12. Estimated Salinity Impacts
Clifton Court Forebay
Middle River Alternative

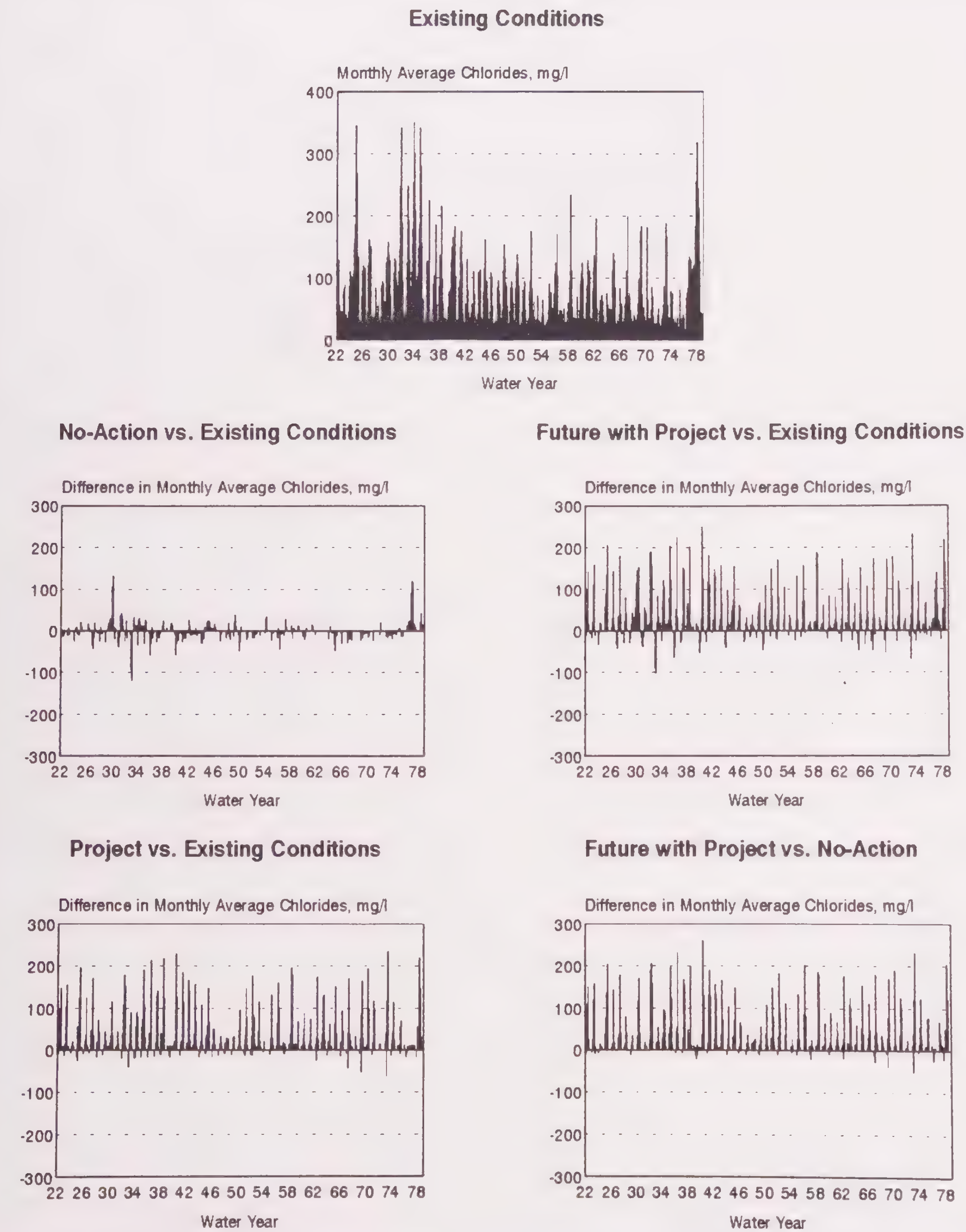

Figure 13. Estimated Salinity Impacts
Contra Costa Canal at Pumping Plant No. 1
Middle River Alternative

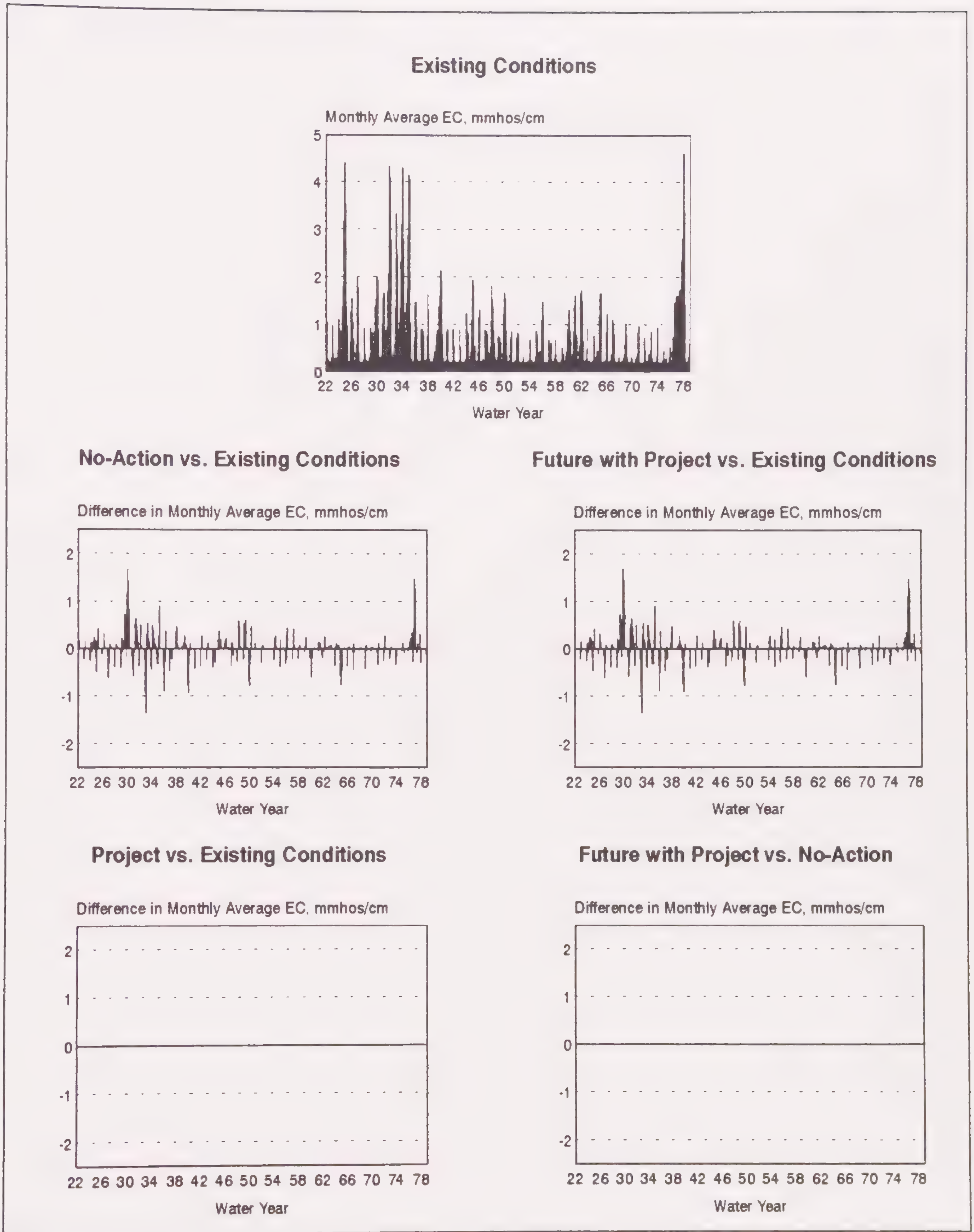

Figure 14. Estimated Salinity Impacts
Sacramento River at Emmaton
Middle River Alternative

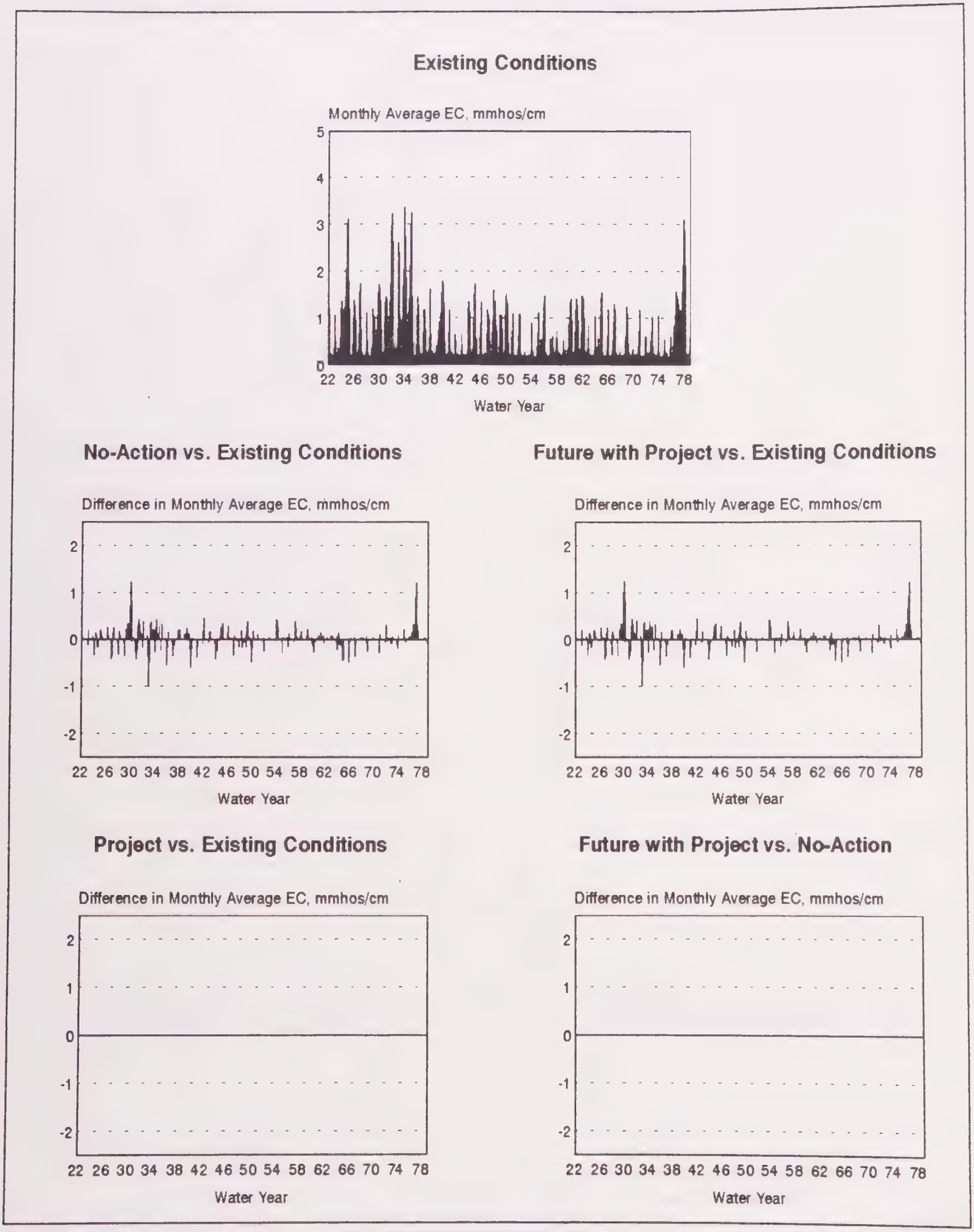

Figure 15. Estimated Salinity Impacts
San Joaquin River at Jersey Point
Middle River Alternative

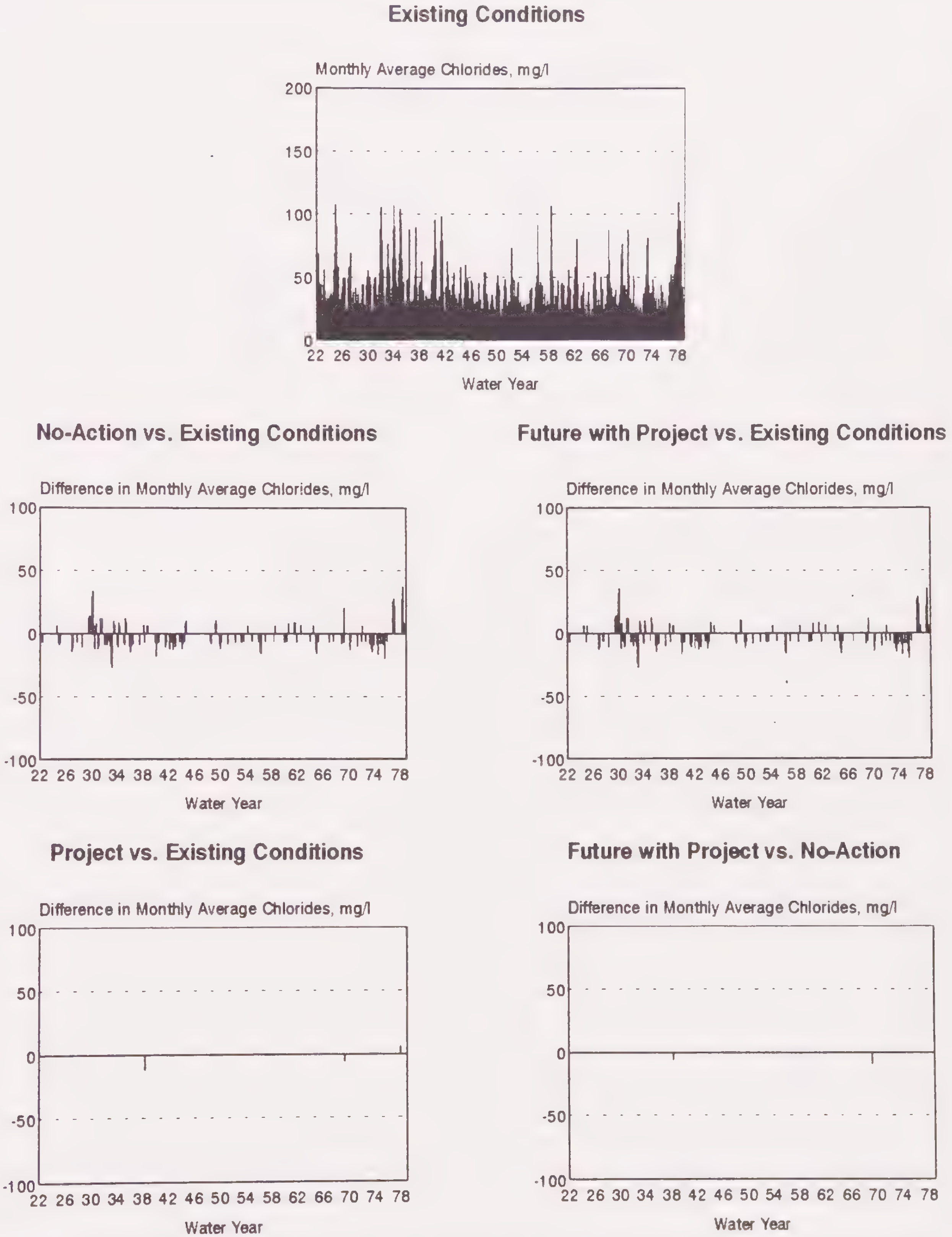

Figure 16. Estimated Salinity Impacts
Middle River at Woodward Island
Middle River Alternative

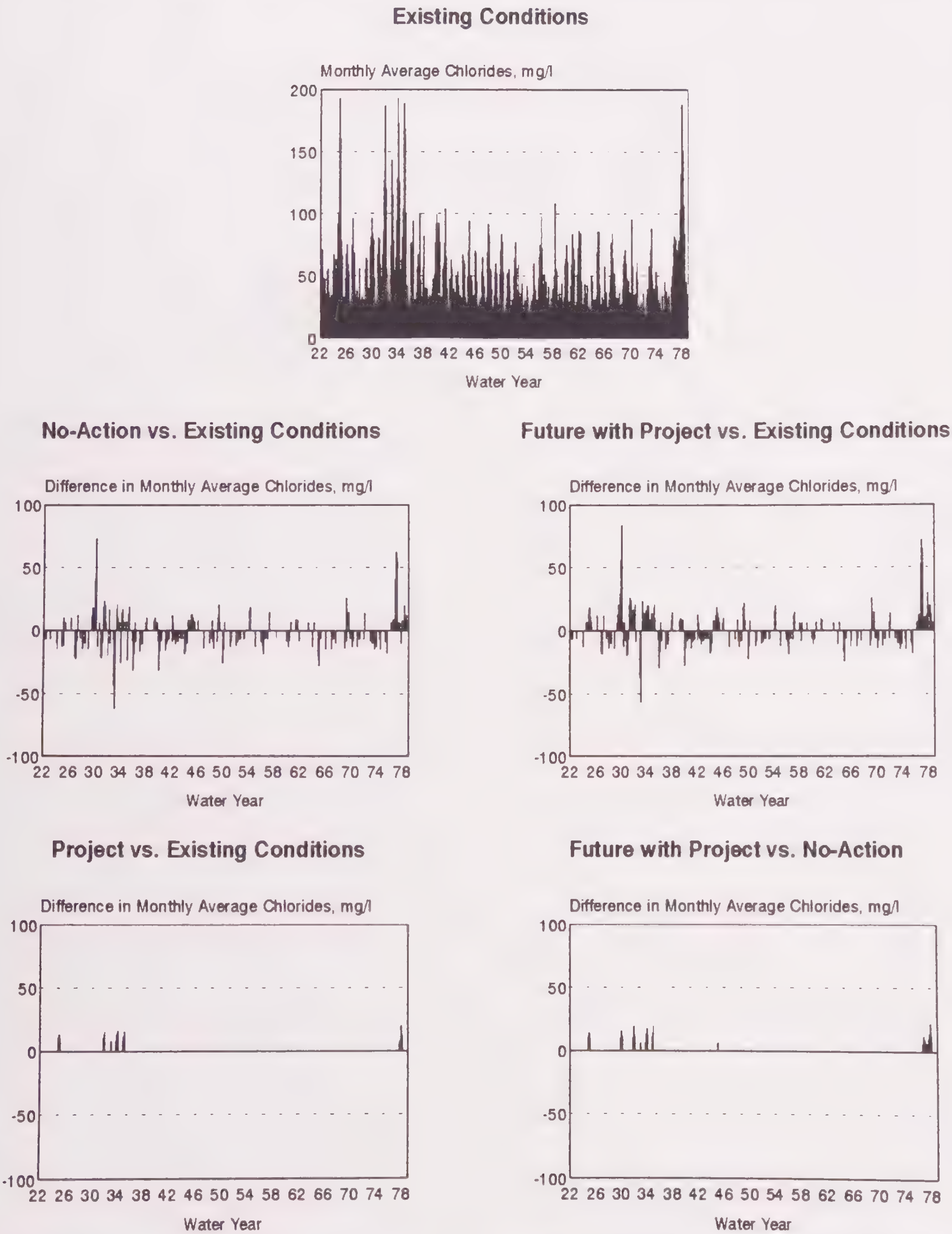

Figure 17. Estimated Salinity Impacts
Old River at Highway 4
Middle River Alternative

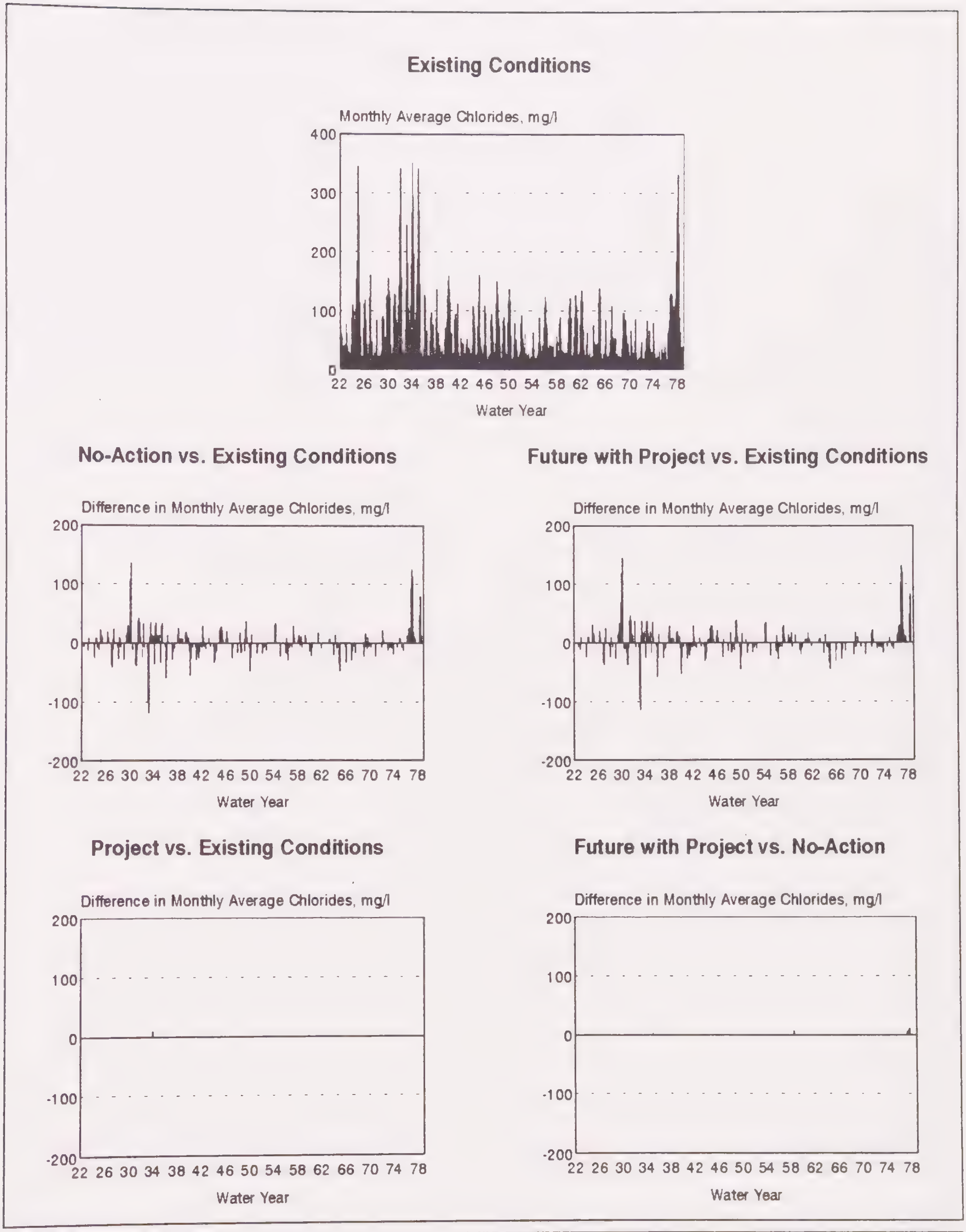

Figure 18. Estimated Salinity Impacts
Old River at Rock Slough
Middle River Alternative

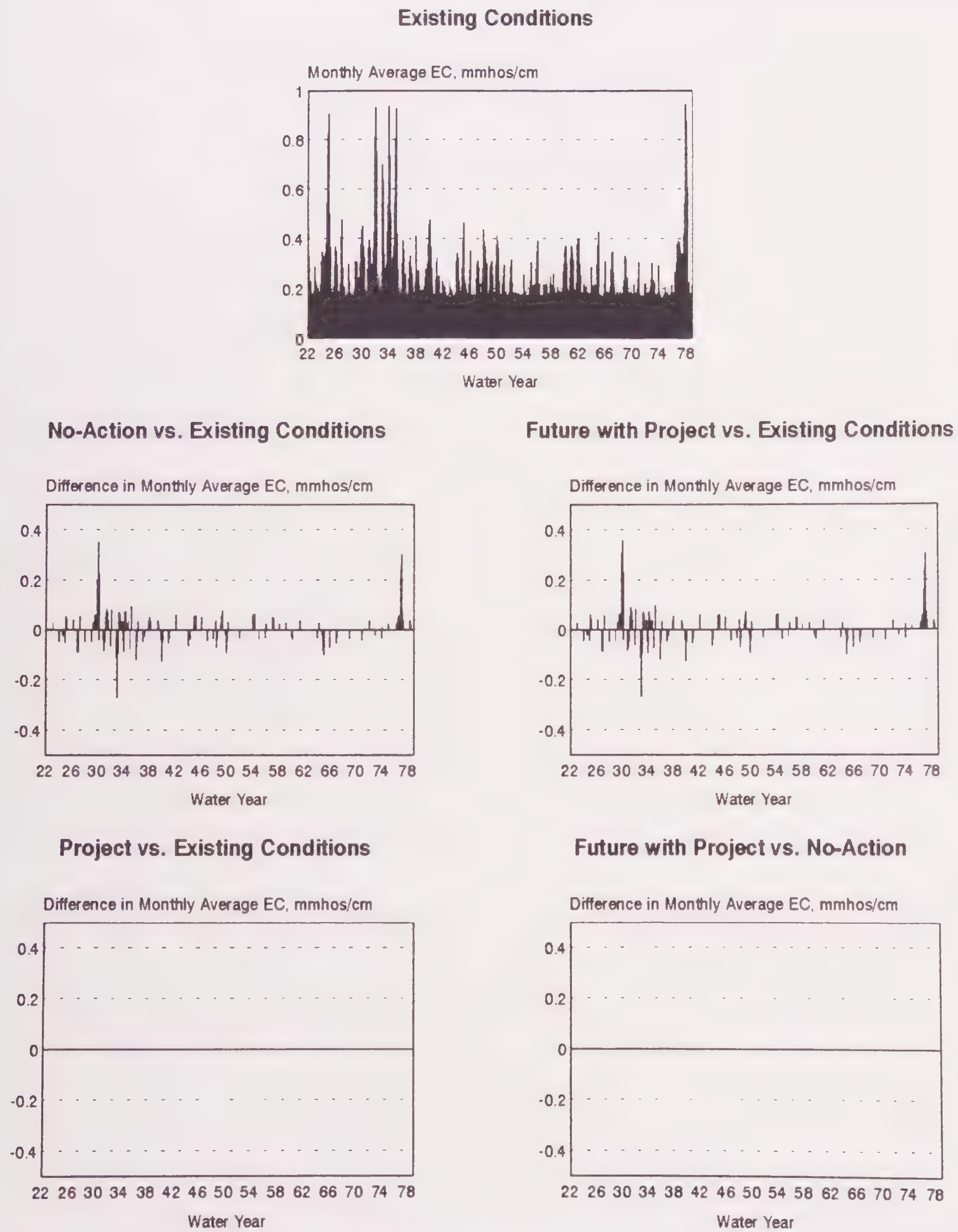

Figure 19. Estimated Salinity Impacts
San Andreas Landing
Middle River Alternative

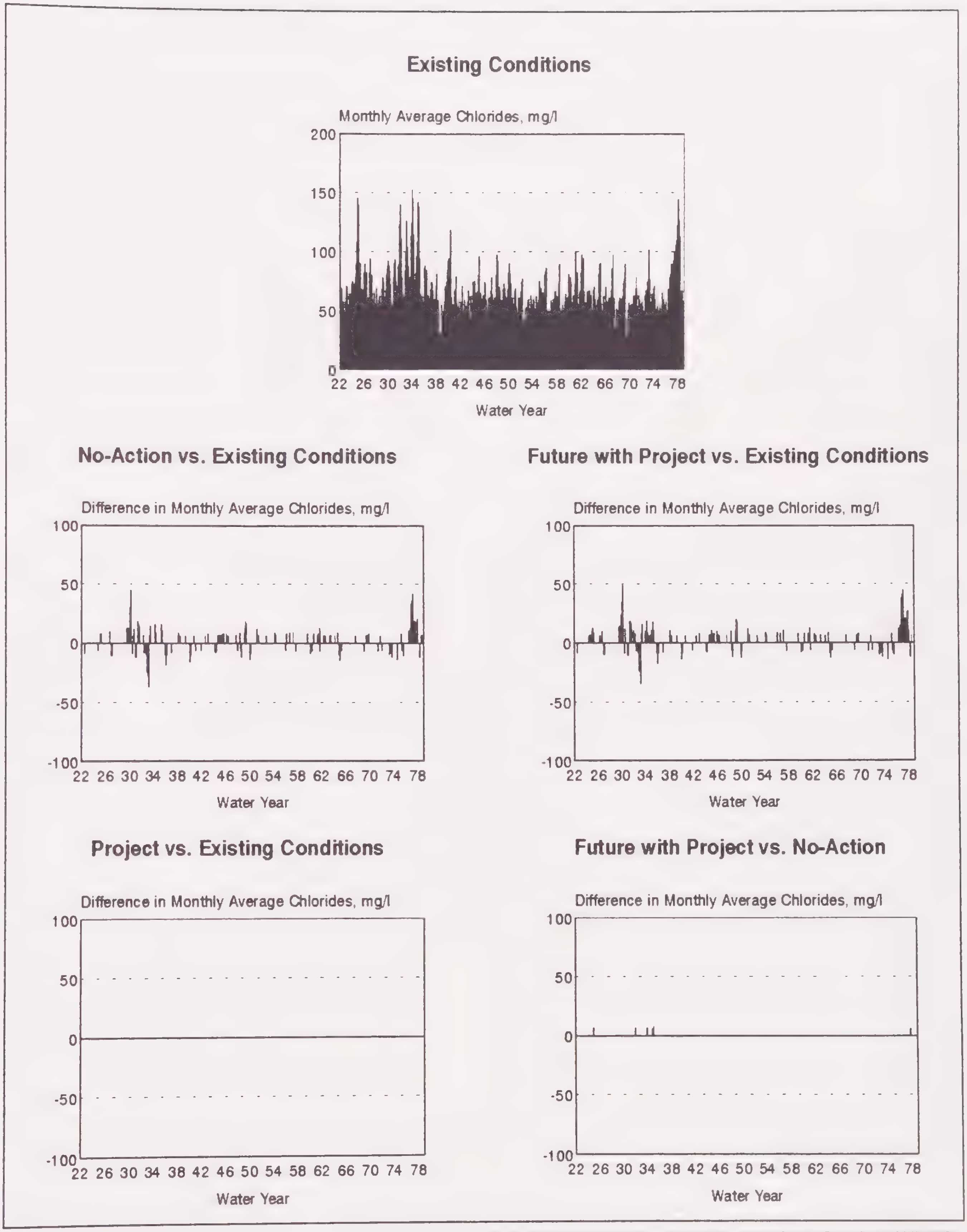

Figure 20. Estimated Salinity Impacts
Tracy Pumping Plant
Middle River Alternative

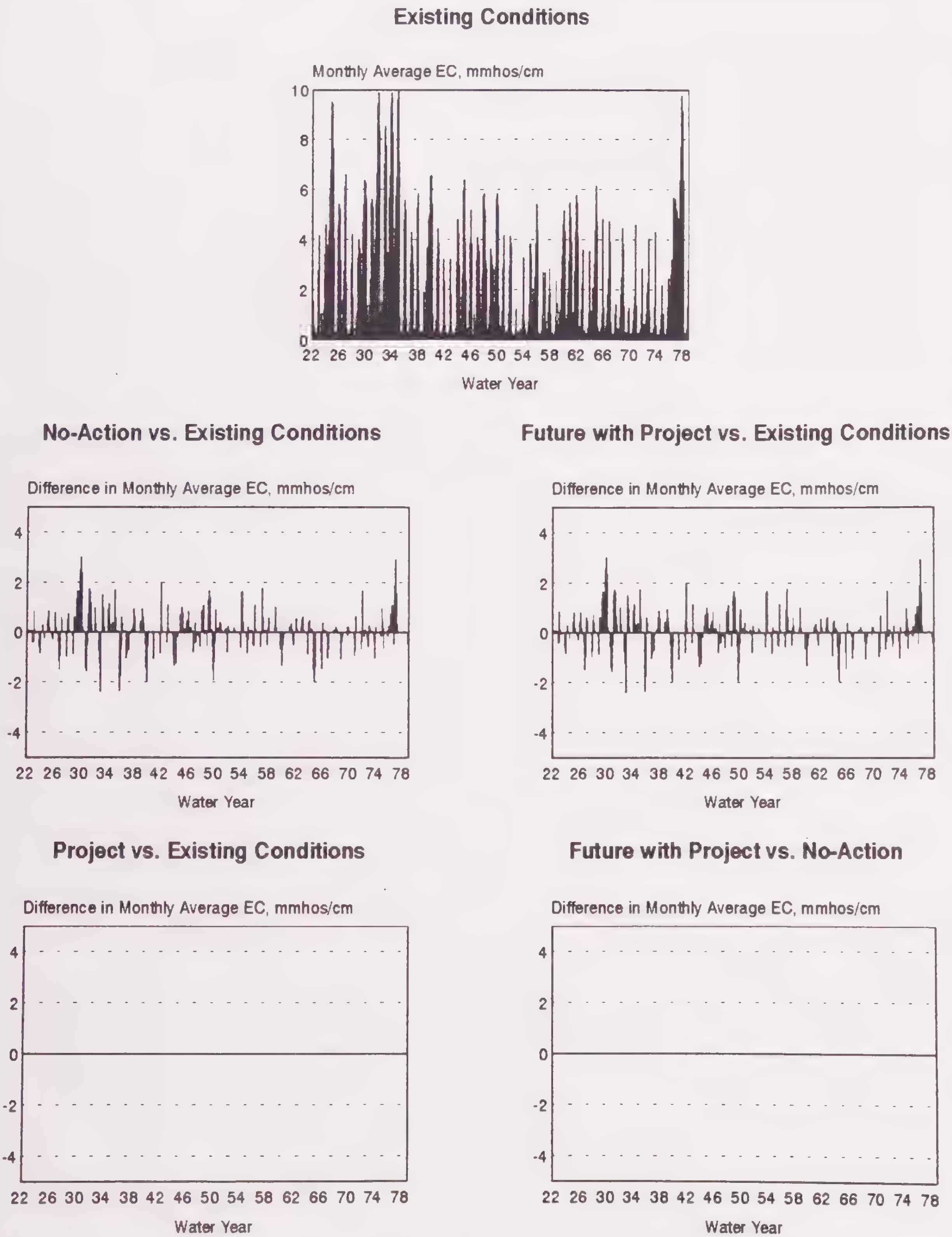

Figure 21. Estimated Salinity Impacts
San Joaquin River at Antioch
Desalination Alternative

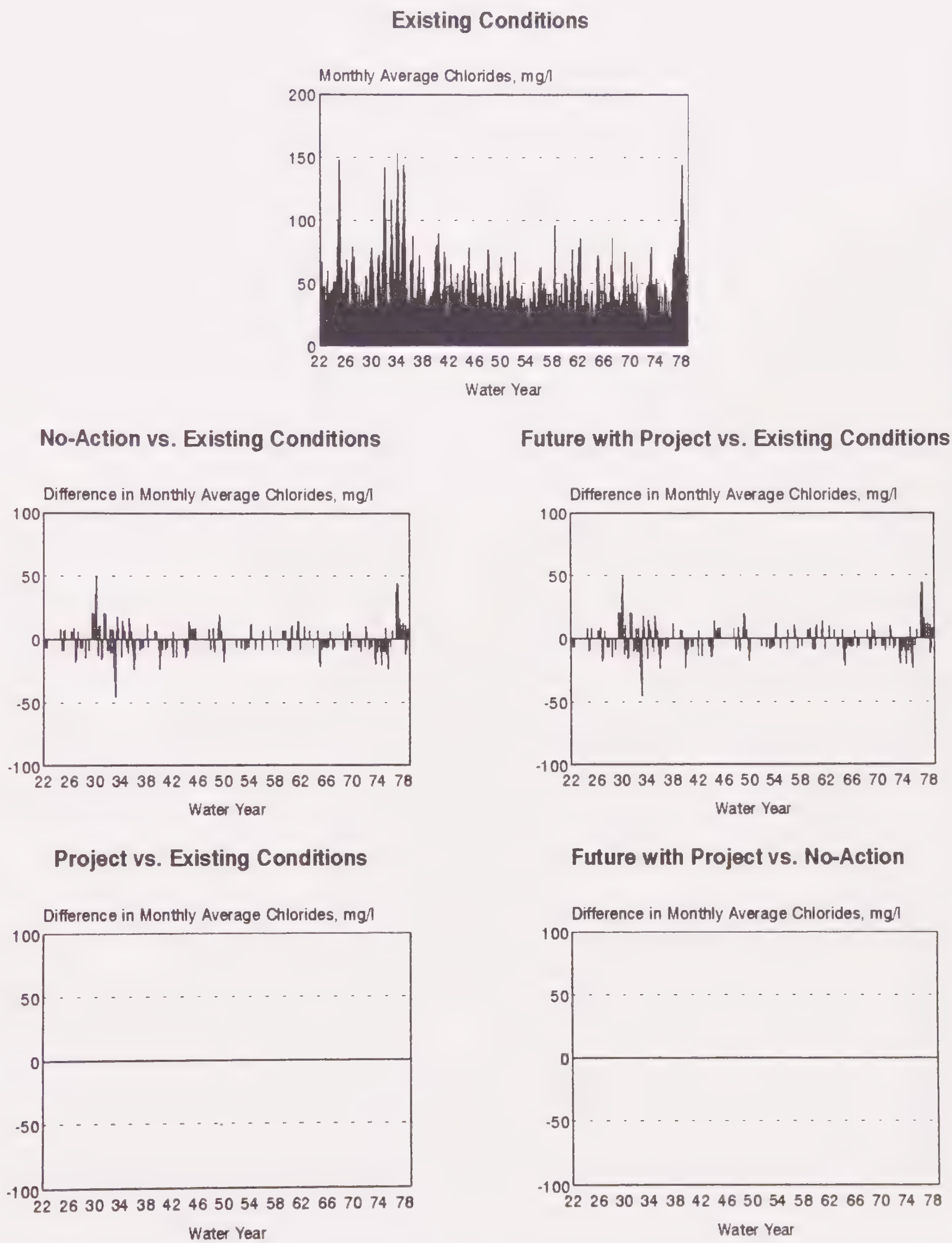

Figure 22. Estimated Salinity Impacts
Clifton Court Forebay
Desalination Alternative

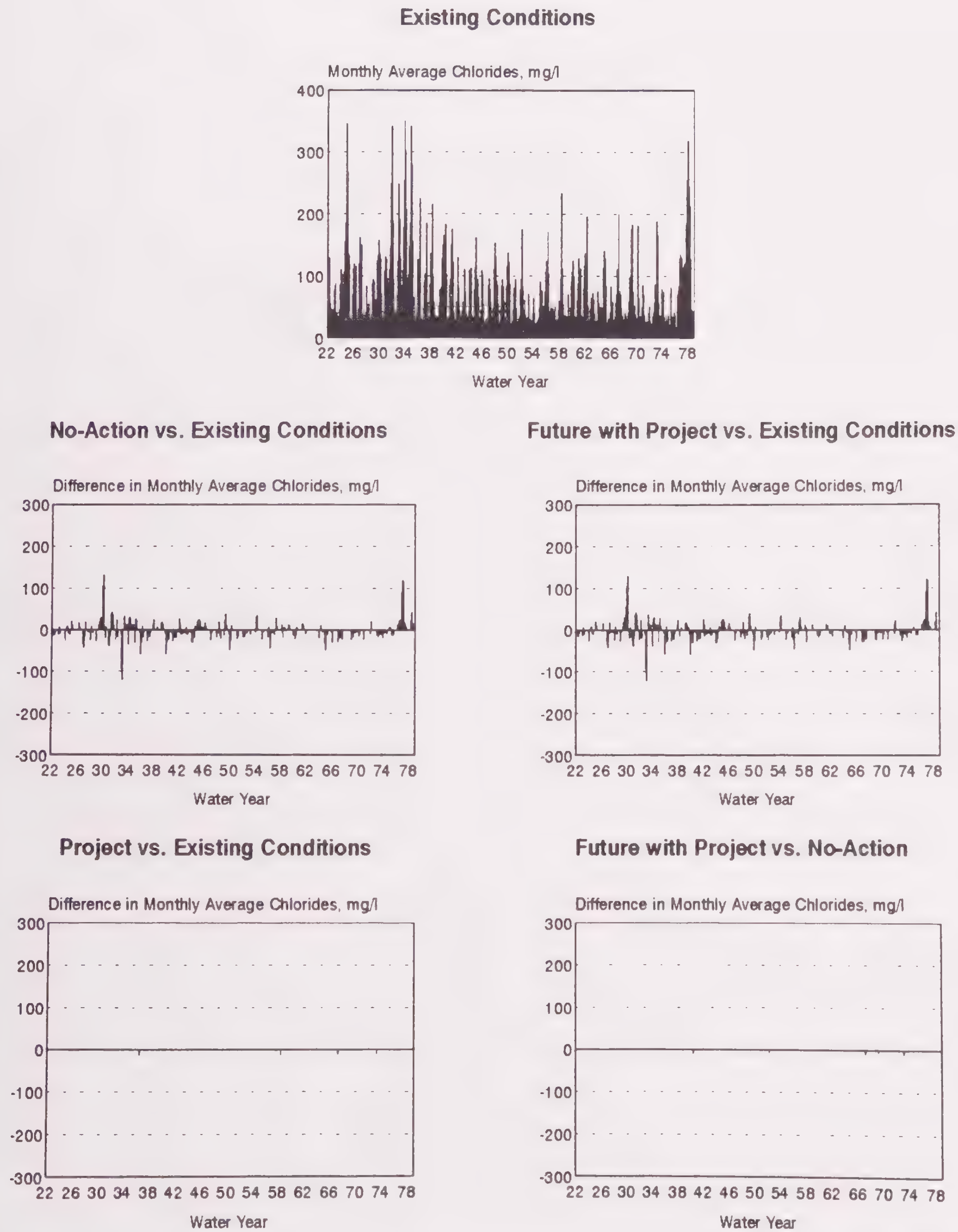

Figure 23. Estimated Salinity Impacts
Contra Costa Canal at Pumping Plant No. 1
Desalination Alternative

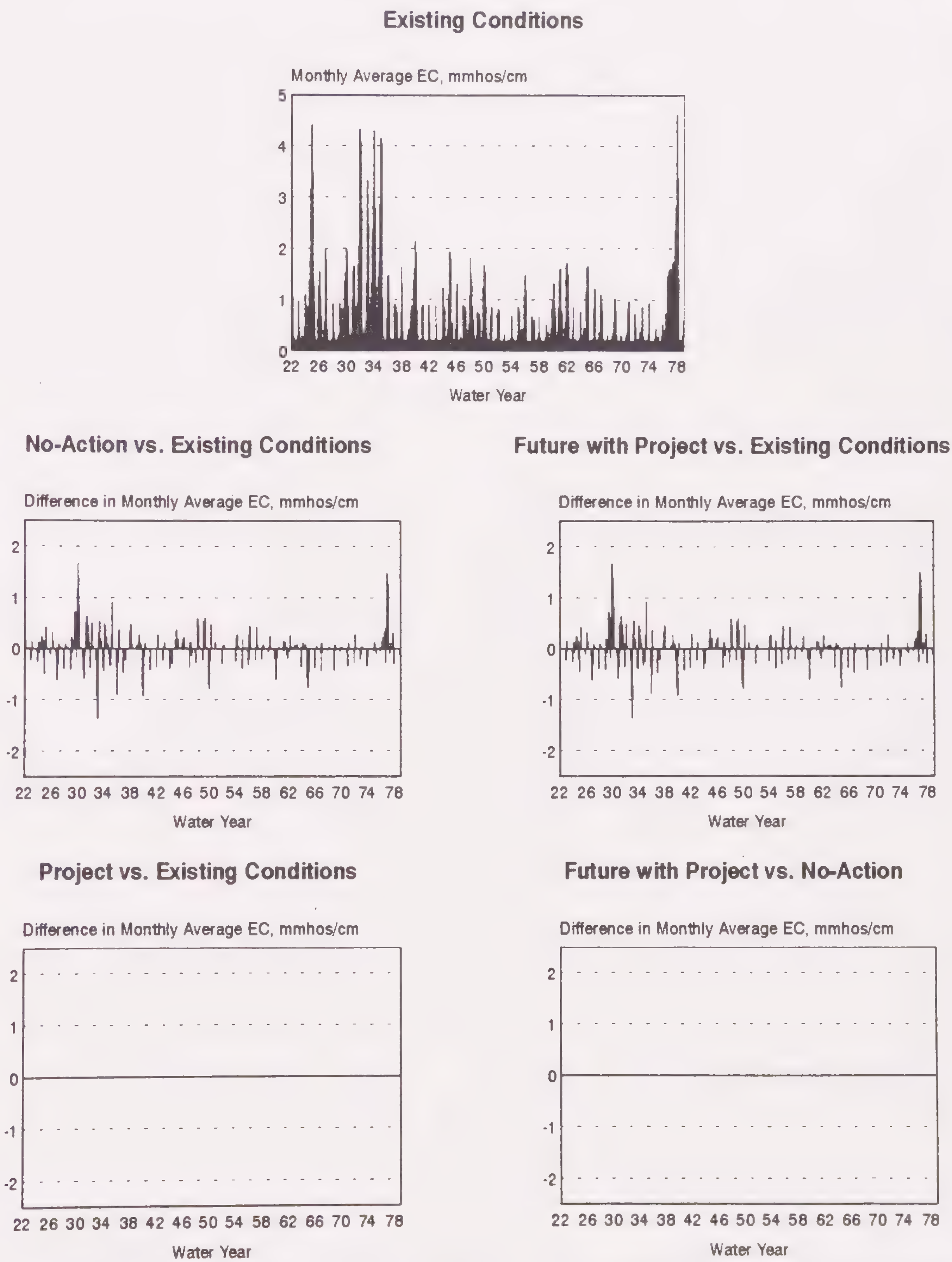

Figure 24. Estimated Salinity Impacts
Sacramento River at Emmaton
Desalination Alternative

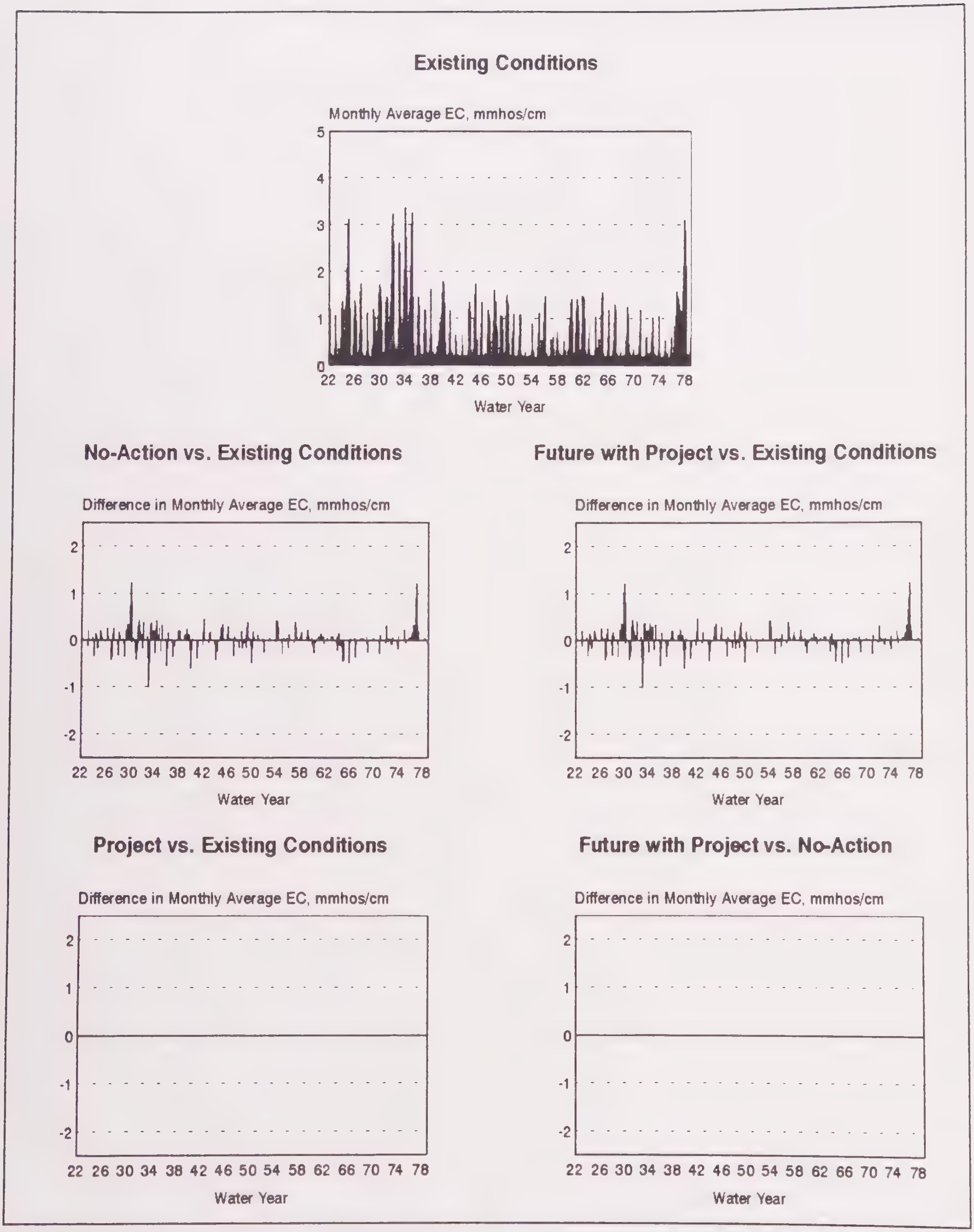

Figure 25. Estimated Salinity Impacts
San Joaquin River at Jersey Point
Desalination Alternative

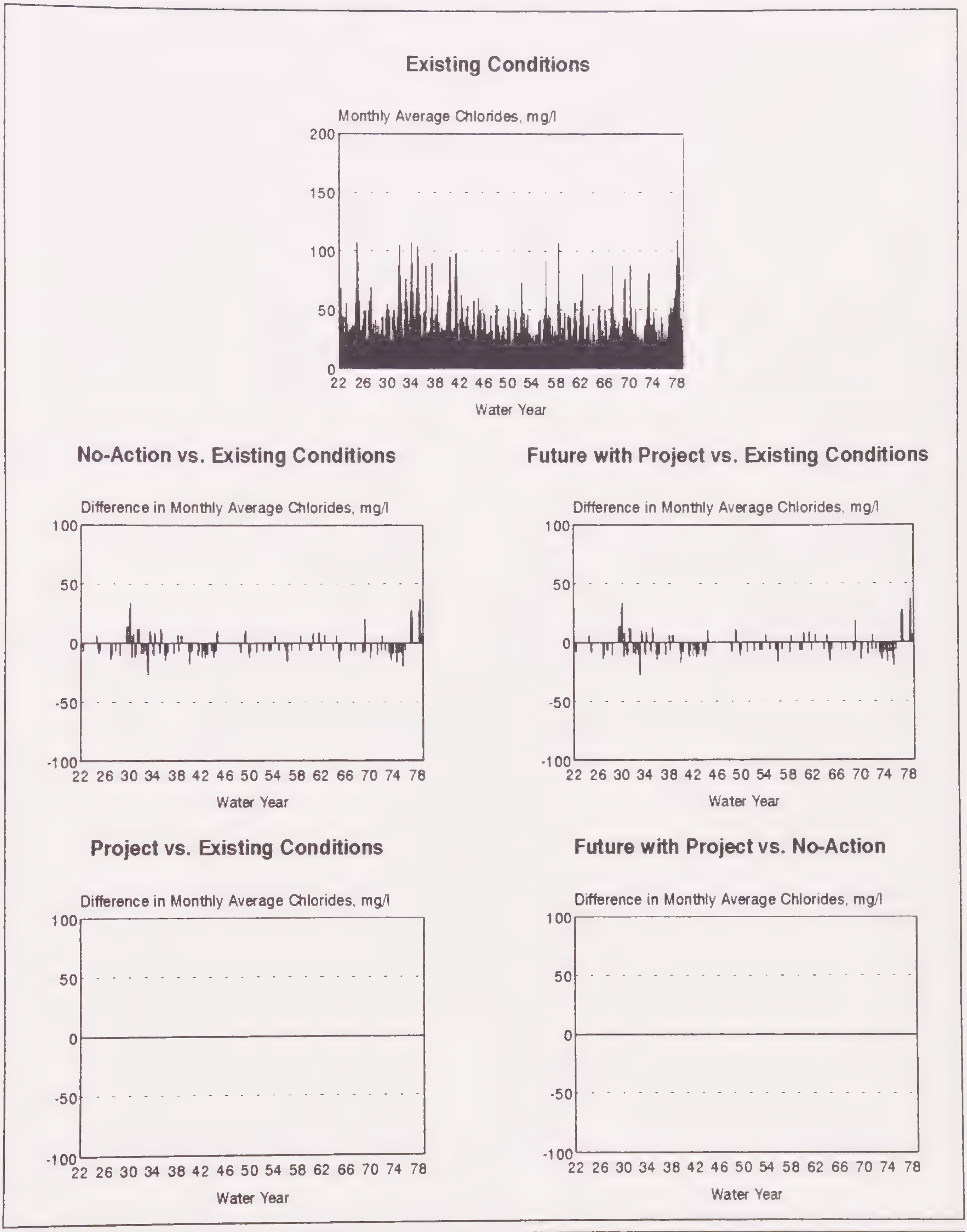

Figure 26. Estimated Salinity Impacts
Middle River at Woodward Island
Desalination Alternative

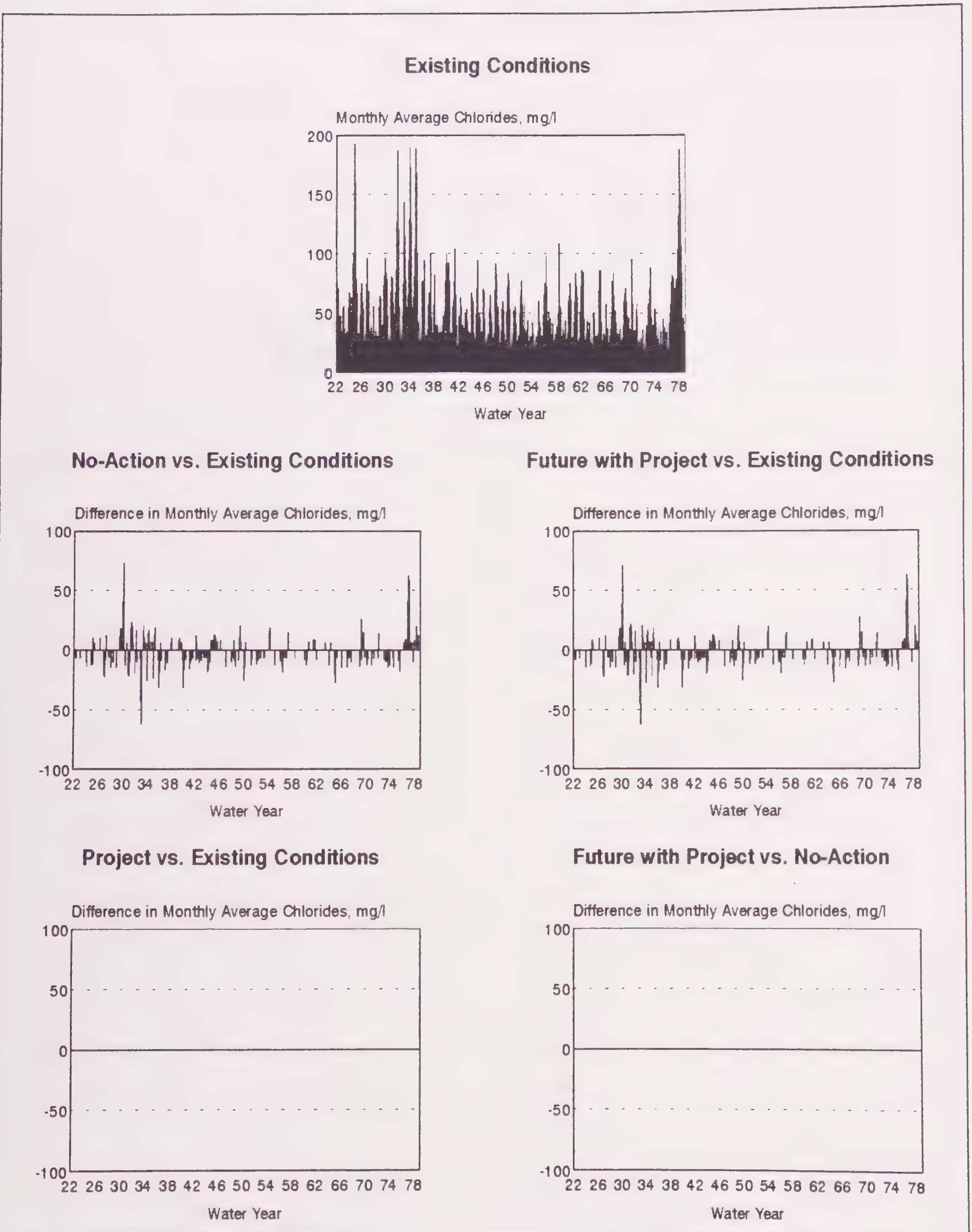

Figure 27. Estimated Salinity Impacts
Old River at Highway 4
Desalination Alternative

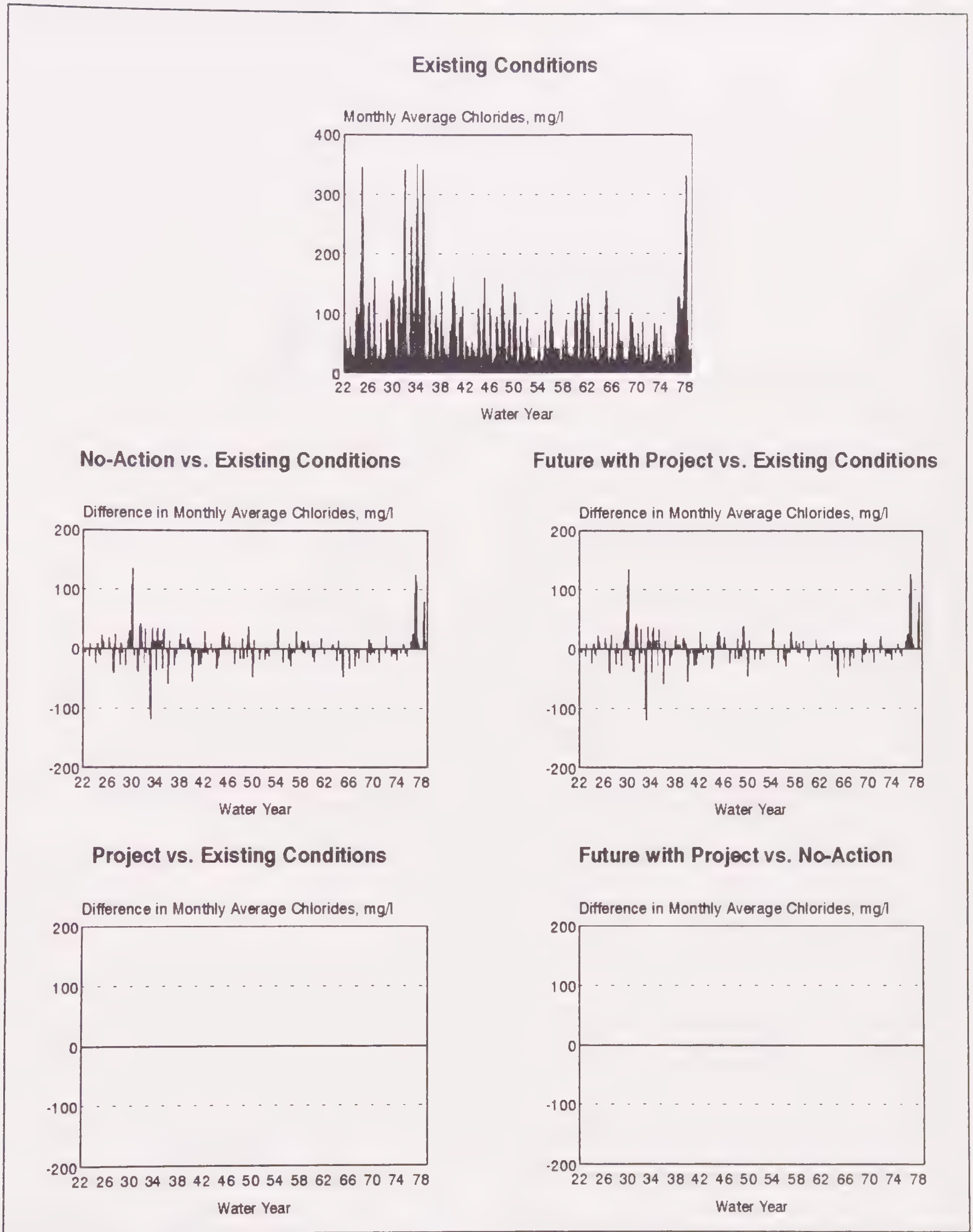

Figure 28. Estimated Salinity Impacts
Old River at Rock Slough
Desalination Alternative

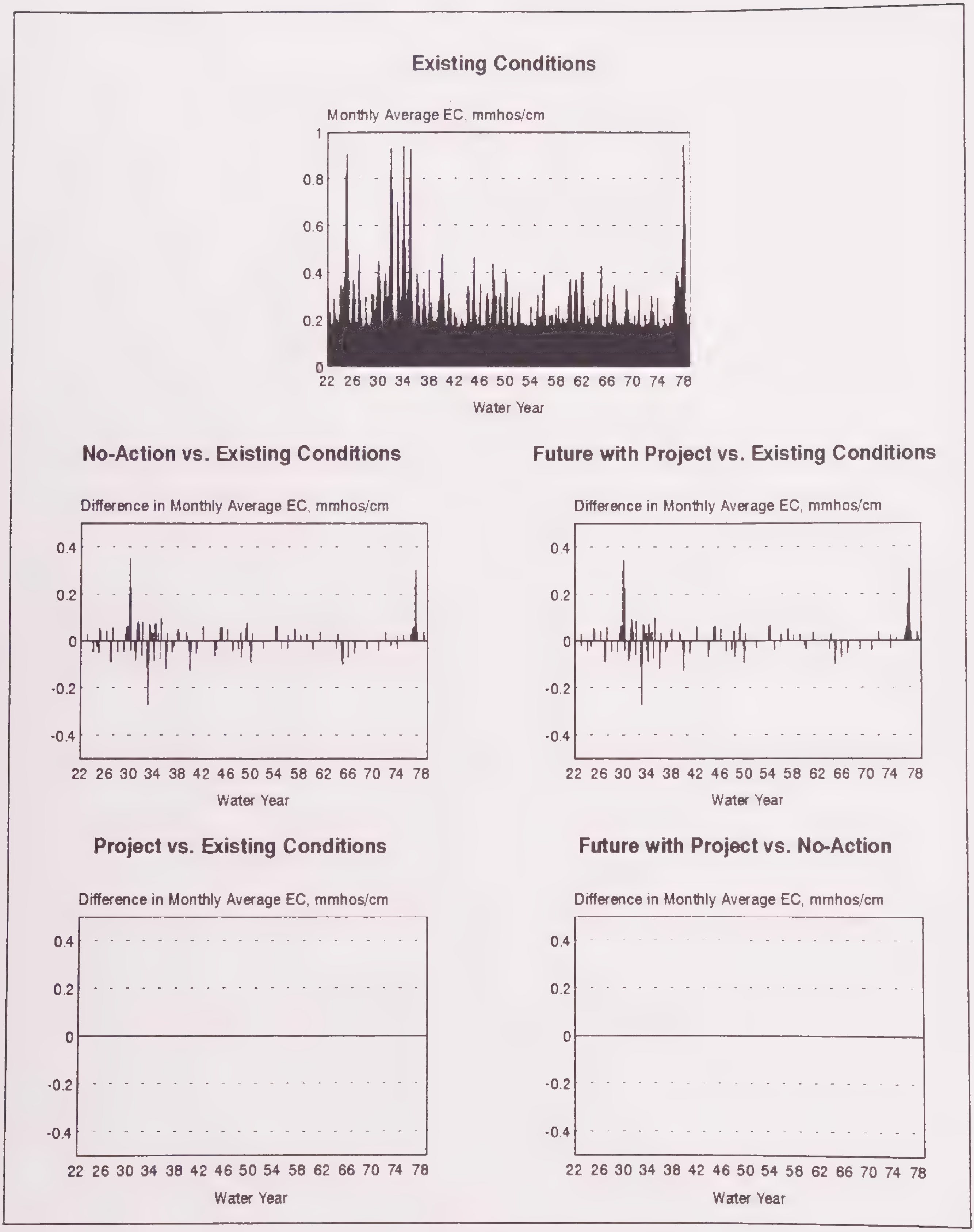

Figure 29. Estimated Salinity Impacts
San Andreas Landing
Desalination Alternative

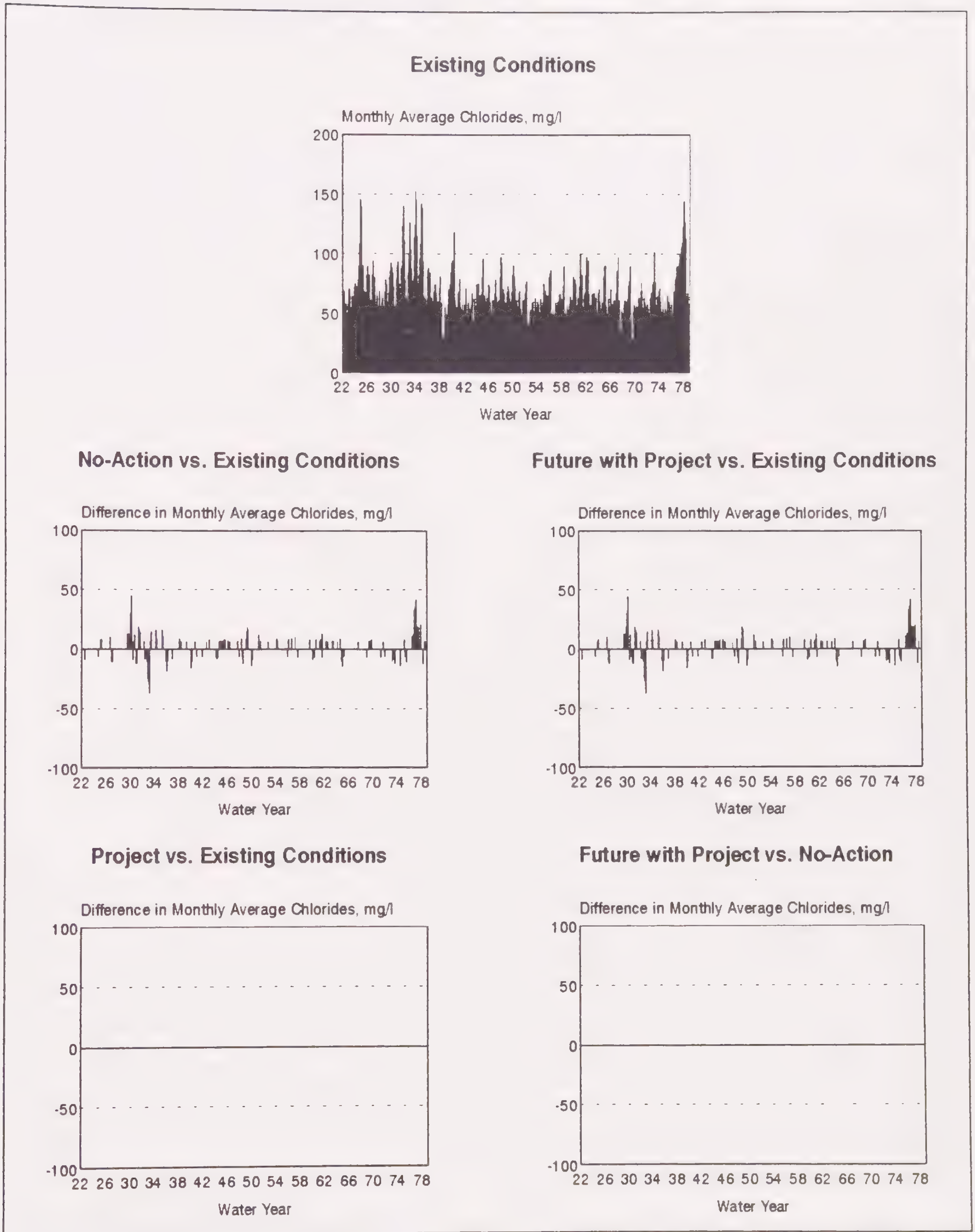

Figure 30. Estimated Salinity Impacts
Tracy Pumping Plant
Desalination Alternative

Section B-4. Summary Performance Characteristics for the Los Vaqueros Project Alternatives

CCWD-rad 24 December, 1991

Data Summaries for Los Vaqueros EIR Alternatives and both Existing and Future Levels of Development

Delivered Chlorides - Project Performance

Existing level of development	No-Action	Res. with ORH4	Res. with ClCt	MRWW	DESALT
Percent of time delivered chloride goal met	58%	91%	94%	92%	91%
Months delivered chloride goal exceeded	284	61	40	52	61
Max number of consecutive months exceeded	30	13	10	9	5

Future level of development	No-Action	Res. with ORH4	Res. with ClCt	MRWW	DESALT
Percent of time delivered chloride goal met	61%	87%	92%	90%	84%
Months delivered chloride goal exceeded	265	91	58	69	107
Max number of consecutive months exceeded	29	19	11	10	12

Delivered Water Quality - Cumulative probability
(Goal = 65 mg/l)

Existing Level of Development

Alternative	Average mg/l	10%	20%	30%	40%	Exceedance 50%	60%	70%	80%	85%	90%	95%	Max
No-Action	71.	25	28	32	39	49	67	84	108	120	135	182	350
Res. w/ORH4	47.	23	26	31	35	41	51	56	64	65	65	81	202
Res. w/ClCt	44.	22	27	31	35	41	46	53	59	62	65	69	155
MRWW	36.	21	24	26	29	33	37	42	47	51	58	77	112
DESALT	43.	19	23	26	31	40	52	63	65	65	65	65	99

Future Level of Development

Alternative	Average mg/l	10%	20%	30%	40%	Exceedance 50%	60%	70%	80%	85%	90%	95%	Max
No-Action	70.	25	28	32	38	49	64	80	104	119	139	183	330
Res. w/ORH4	49.	23	27	31	34	41	49	58	64	65	73	103	208
Res. w/ClCt	46.	23	27	31	34	40	46	53	61	64	65	89	166
MRWW	39.	22	25	27	30	32	37	43	49	53	66	87	127
DESALT	46.	21	24	28	33	42	53	64	65	65	65	79	167

Percent of time less than a given delivered chloride concentration

Existing Level of Development

% time <	65.	75.	85.	95.	105.	115.	125.	135.	145.	155.	165. mg/l
No-Action	58	64	70	75	79	83	86	90	91	93	94
w/ORH4	91	93	95	96	96	97	97	98	98	99	99
w/ClCt	94	96	96	97	98	98	99	99	99	100	100
MRWW	92	95	96	99	99	100	100	100	100	100	100
DESALT	76	99	99	99	100	100	100	100	100	100	100

Future Level of Development

% time <	65.	75.	85.	95.	105.	115.	125.	135.	145.	155.	165. mg/l
No-Action	61	67	72	77	80	83	87	89	91	92	94
w/ORH4	87	91	93	94	95	95	96	97	98	98	98
w/ClCt	92	93	95	95	96	97	98	98	99	99	100
MRWW	90	93	95	97	98	99	100	100	100	100	100
DESALT	73	95	96	96	98	99	99	99	99	99	100

No-Action Base Case - Water Quality at Potential Intake Locations (mg/l)

Existing level of development

Intake	Average mg/l	Exceedance 10%	20%	30%	40%	50%	60%	70%	80%	85%	90%	95%	100%
RkSl	70.6	25	28	32	39	49	67	84	108	120	135	182	350
ORH4	46.9	22	25	29	32	38	47	54	65	73	80	95	193
ClCt	44.3	23	27	31	35	40	44	49	58	63	71	85	153
MRWW	37.1	21	24	27	30	33	36	41	47	50	56	76	109

Future level of development

Intake	Average mg/l	Exceedance 10%	20%	30%	40%	50%	60%	70%	80%	85%	90%	95%	100%
RkSl	69.9	25	28	32	38	49	64	80	104	119	139	183	330
ORH4	46.1	22	25	29	31	37	44	52	64	69	80	96	184
ClCt	43.6	22	26	30	35	38	42	48	57	62	70	90	142
MRWW	36.0	21	23	26	28	31	34	40	45	49	59	75	106

No-Action Base Case - Percent of intake chlorides less than given chloride concentration

Existing level of development

% time <	50.	55.	60.	65.	75.	85.	95.	105.	125.	145.	165. mg/l
RkSl	50	52	56	58	64	70	75	79	86	91	94
ORH4	64	71	75	80	85	92	95	96	97	98	99
ClCt	71	77	82	85	91	95	96	97	99	100	100
MRWW	84	88	91	92	95	96	98	99	100	100	100

Future level of development

% time <	50.	55.	60.	65.	75.	85.	95.	105.	125.	145.	165. mg/l
RkSl	51	53	57	61	67	72	77	80	87	91	94
ORH4	68	73	76	81	88	92	94	96	96	98	99
ClCt	72	77	82	87	92	94	96	96	98	100	100
MRWW	86	89	90	92	95	97	99	100	100	100	100

Summary of Intake Water Quality for Reservoir Alternative Studies

(a) Rock Slough Intake Water Quality (mg/l, chlorides)

Cumulative Probability

Existing level of development

Alternative	Average mg/l	10%	20%	30%	40%	50%	60%	70%	80%	90%	Max
					Exceedance						
No-Action	70.6	25	28	32	39	49	67	84	108	135	350
w/ORH4	87.0	27	31	36	44	62	80	103	132	189	377
w/ClCt	86.4	26	31	35	45	62	80	103	131	181	362
MRWW	93.1	29	35	40	52	69	91	113	139	192	350
DESALT	70.3	24	28	32	39	50	68	84	107	134	348

Future level of development

Alternative	Average mg/l	10%	20%	30%	40%	50%	60%	70%	80%	90%	Max
					Exceedance						
No-Action	69.9	25	28	32	38	49	64	80	104	139	330
w/ORH4	86.8	26	30	36	45	57	76	98	128	205	390
w/ClCt	86.0	25	30	35	45	59	76	99	128	195	381
MRWW	93.4	28	33	38	51	67	88	111	141	213	353
DESALT	69.6	24	28	32	38	49	64	81	105	139	333

Percent of time less than a given delivered chloride concentration

Existing level of development

% time <	65.	75.	85.	95.	105.	115.	125.	135.	145.	155.	165. mg/l
No-Action	58	64	70	75	79	83	86	90	91	93	94
w/ORH4	53	57	63	67	70	74	77	81	83	86	87
w/ClCt	53	58	62	67	70	74	77	81	83	86	88
MRWW	47	52	57	62	67	71	74	79	82	85	87
DESALT	59	64	71	76	79	83	87	90	92	93	94

Future level of development

% time <	65.	75.	85.	95.	105.	115.	125.	135.	145.	155.	165. mg/l
No-Action	61	67	72	77	80	83	87	90	91	92	94
w/ORH4	54	59	65	69	72	75	79	82	83	85	87
w/ClCt	54	59	64	68	72	76	79	82	84	85	87
MRWW	48	54	58	63	67	72	75	78	80	83	85
DESALT	61	67	72	77	80	83	87	90	91	93	94

(b) Supplemental Intake Water Quality (mg/l, chlorides)

Cumulative Probability

Existing level of development

Alternative	Average mg/l	Exceedance 10%	20%	30%	40%	50%	60%	70%	80%	90%	Max
w/ORH4	47.8	22	25	29	33	38	47	55	66	83	202
w/ClCt	44.3	22	26	31	35	40	44	49	58	72	155
MRWW	37.4	21	24	27	30	33	37	42	47	58	112

Future level of development

Alternative	Average mg/l	Exceedance 10%	20%	30%	40%	50%	60%	70%	80%	90%	Max
w/ORH4	47.3	22	25	29	32	38	44	53	65	84	193
w/ClCt	43.8	22	26	30	35	38	42	48	58	71	152
MRWW	36.3	21	23	26	28	31	35	40	45	59	109

Percent of time less than a given delivered chloride concentration

Existing level of development

% time <	65.	75.	85.	95.	105.	115.	125.	135.	145.	155.	165. mg/l
w/ORH4	79	85	92	94	96	97	97	98	98	99	99
w/ClCt	85	91	95	96	97	98	99	99	99	100	100
MRWW	93	95	96	98	99	100	100	100	100	100	100

Future level of development

% time <	65.	75.	85.	95.	105.	115.	125.	135.	145.	155.	165. mg/l
w/ORH4	80	87	91	94	95	96	96	97	98	98	99
w/ClCt	87	92	94	96	97	98	99	99	100	100	100
MRWW	92	95	97	98	100	100	100	100	100	100	100

RESERVOIR PERFORMANCE

	Exist. w/ORH4	Exist. w/ClCt	Future w/ORH4	Future w/ClCt
Percent of time delivered chloride goal met	91%	94%	87%	92%
Months delivered chloride goal exceeded	61	40	91	58
Max number of consecutive months exceeded	13	10	19	11
Months with forced releases	28	54	22	38
Months there were reservoir releases	169	158	132	118
Months there was reservoir filling	188	192	167	172
Months with both filling and releasing	33	33	24	18
Months at or below emergency storage level (Blending water not available to CCWD)	101	71	151	144

Note: Emergency storage levels were 57,000 acre-feet for wet and normal years, and 30,000 acre-feet for dry and critical years.

Summary of Reservoir Quality (desired maximum is 50 mg/l)

Alternative	Average mg/l	Exceedance 10%	20%	30%	40%	50%	60%	70%	80%	90%	Max
Exist. w/ORH4	48.1	43	45	46	47	48	49	50	51	53	60
Exist. w/ClCt	49.9	46	48	49	49	50	50	51	52	54	61
Future w/ORH4	48.9	44	46	47	48	49	50	50	52	54	63
Future w/ClCt	49.7	45	47	48	49	50	50	51	52	54	62

Summary of Reservoir Storage (maximum reservoir capacity is 100 TAF)

Alternative	Average TAF	Exceedance 10%	20%	30%	40%	50%	60%	70%	80%	90%	Max
Exist. w/ORH4	84.9	49	69	77	89	96	97	99	100	100	100
Exist. w/ClCt	86.4	56	73	82	90	96	97	99	100	100	100
Future w/ORH4	81.8	47	59	70	85	93	97	98	100	100	100
Future w/ClCt	81.9	51	59	71	82	91	96	98	100	100	100

% time <	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110. TAF
Exist. w/ORH4	0	0	0	0	10	15	22	32	41	86	100
Exist. w/ClCt	0	0	0	0	8	11	16	27	40	86	100
Future w/ORH4	0	0	0	2	12	20	29	38	46	88	100
Future w/ClCt	0	0	0	1	10	21	28	37	49	87	100

SUMMARY OF PIPE FLOWS (cfs)

Note: All averages are based on non-zero values only, i.e only when the pipeline is being used.

Transfer Reservoir to Canal (maximum 400 cfs)

Alternative	Average cfs	Exceedance 10%	20%	30%	40%	50%	60%	70%	80%	90%	Max
Exist. w/ORH4	150.9	0	45	82	98	131	174	195	221	250	263
Exist. w/ClCt	145.4	0	21	81	90	118	148	174	215	250	263
Future w/ORH4	181.2	5	89	105	128	194	227	250	250	250	397
Future w/ClCt	163.1	3	25	98	120	155	194	244	250	250	397

From Supplemental Intake Down to Canal (maximum 250 cfs) - Direct Diversion

Alternative	Average cfs	Exceedance 10%	20%	30%	40%	50%	60%	70%	80%	90%	Max
Exist. w/ORH4	136.0	0	31	73	86	98	131	174	215	250	250
Exist. w/ClCt	133.7	0	8	67	84	98	129	161	195	242	250
Future w/ORH4	168.1	4	72	99	124	162	207	250	250	250	250
Future w/ClCt	150.9	1	15	85	103	128	168	210	250	250	250

Supplemental Intake Up to Reservoir (maximum 200 cfs) - Filling

Alternative	Average cfs	Exceedance 10%	20%	30%	40%	50%	60%	70%	80%	90%	Max
Exist. w/ORH4	70.9	0	0	0	0	0	0	0	9	66	200
Exist. w/ClCt	72.1	0	0	0	0	0	0	0	11	81	200
Future w/ORH4	73.1	0	0	0	0	0	0	0	6	61	200
Future w/ClCt	73.4	0	0	0	0	0	0	0	6	68	200

Reservoir Down To Contra Costa Canal (maximum 400 cfs) - Releasing

Alternative	Average cfs	Exceedance 10%	20%	30%	40%	50%	60%	70%	80%	90%	Max
Exist. w/ORH4	63.0	0	0	0	0	0	0	0	18	79	217
Exist. w/ClCt	67.0	0	0	0	0	0	0	0	12	87	180
Future w/ORH4	72.7	0	0	0	0	0	0	0	2	52	257
Future w/ClCt	80.4	0	0	0	0	0	0	0	0	61	220

Pipeline Up to Reservoir (maximum 200 cfs) - Filling

Alternative	Average cfs	Exceedance 10%	20%	30%	40%	50%	60%	70%	80%	90%	Max
Exist. w/ORH4	-71.1	-200	-168	-105	-63	-43	-20	-13	-8	-4	-200
Exist. w/ClCt	-70.6	-200	-160	-103	-66	-50	-16	-13	-9	-5	-200
Future w/ORH4	-74.6	-200	-162	-111	-69	-52	-22	-13	-8	-5	-200
Future w/ClCt	-75.4	-199	-169	-123	-76	-55	-16	-13	-8	-4	-200

Note: Exceedance based on negative (filling) flows only.

Total Volumes Delivered From Supplemental Intake and Reservoir 1922-78 (TAF)

Alternative	Transfer to Canal	Reservoir Release	Reservoir Fill	Reservoir Net
Exist. w/ORH4	5426	542	-748	-206
Exist. w/ClCt	5145	562	-782	-220
Future w/ORH4	6871	511	-700	-189
Future w/ClCt	6153	515	-722	-206

Average Monthly NET CCWD DELTA Diversions
Relative to Corresponding No-Action Case (TAF/mth)

Existing level of development

Alternative	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	TOTAL
w/ORH4	-1.39	0.72	1.48	1.00	0.80	1.87	2.04	1.51	-0.69	-1.91	-0.72	-1.10	3.61
w/ClCt	-0.98	1.45	1.88	1.26	1.10	2.06	1.80	0.83	-1.48	-2.77	-0.52	-0.76	3.86
DESALT	1.07	0.92	0.73	0.65	0.55	0.50	0.48	0.53	0.58	0.75	0.76	0.90	8.44

Future level of development

Alternative	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	TOTAL
w/ORH4	-1.07	0.65	1.64	1.09	0.95	1.99	2.20	0.44	-0.91	-2.24	-0.71	-0.69	3.32
w/ClCt	-0.74	1.36	2.05	1.56	1.10	2.50	2.05	-0.56	-1.65	-2.95	-0.51	-0.59	3.62
DESALT	1.08	1.05	0.91	0.76	0.61	0.58	0.55	0.63	0.68	0.74	0.82	0.95	9.35

Average Monthly Total CCWD DELTA Diversions (TAF/mth)

Existing level of development

Alternative	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	TOTAL
w/ORH4	9.49	9.63	8.94	7.20	5.82	7.51	7.84	12.65	12.70	13.72	15.74	11.78	123.02
w/ClCt	9.89	10.36	9.34	7.47	6.12	7.70	7.60	11.97	11.91	12.86	15.94	12.12	123.27
DESALT	11.95	9.82	8.19	6.85	5.56	6.15	6.29	11.68	13.96	16.38	17.24	13.78	127.83

Future level of development

Alternative	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	TOTAL
w/ORH4	14.64	12.97	11.82	9.13	7.20	9.08	10.03	17.65	20.20	22.44	25.24	18.62	179.01
w/ClCt	14.97	13.68	12.23	9.60	7.35	9.59	9.88	16.65	19.45	21.74	25.44	18.73	179.30
DESALT	16.80	13.38	11.08	8.81	6.87	7.67	8.39	17.84	21.78	25.43	26.78	20.25	185.06

NET Annual Change in CCWD DELTA Diversions from No-Action Case (TAF)

Water Year	Existing level of development w/ORH4	Existing level of development w/ClCt	Existing level of development DESALT	Future level of development w/ORH4	Future level of development w/ClCt	Future level of development DESALT
1922	25.16	25.61	6.45	25.63	25.61	7.05
1923	-2.62	-9.85	5.85	-5.50	-22.61	5.90
1924	-39.98	-33.31	14.51	-39.75	-22.26	15.43
1925	24.20	24.18	11.40	11.87	11.87	13.11
1926	8.23	18.96	9.23	11.29	11.86	10.66
1927	32.31	21.67	7.71	36.92	40.63	8.07
1928	5.10	5.11	6.01	8.41	4.35	5.62
1929	-15.00	-5.01	11.36	-36.12	-25.73	14.71
1930	-0.86	12.38	10.29	2.08	-8.12	11.90
1931	-22.58	-33.02	15.31	-7.38	-6.47	20.13
1932	4.79	-4.70	11.76	12.03	12.74	12.48
1933	-1.34	-2.65	16.64	-6.05	-6.98	19.88
1934	2.24	3.29	18.42	0.00	0.00	23.00
1935	36.08	30.43	10.74	24.00	23.68	11.96
1936	26.82	30.99	8.34	13.77	13.56	7.91
1937	1.48	2.12	7.85	1.27	1.36	8.50
1938	6.66	6.21	7.49	31.46	31.70	8.90
1939	-17.95	-25.85	10.78	-18.66	-6.80	12.30
1940	-0.05	6.86	10.08	-4.62	3.45	10.77
1941	12.23	25.02	7.31	17.26	9.67	7.25
1942	15.57	4.09	5.97	15.67	5.67	6.07
1943	4.32	4.31	5.82	4.32	-4.68	5.85
1944	0.70	-16.47	8.16	-7.59	-19.43	8.80
1945	9.58	-0.62	7.69	-18.47	-10.67	9.62
1946	5.10	31.53	6.76	31.07	30.71	8.30
1947	-19.55	-10.84	7.63	11.47	22.77	8.07
1948	18.02	15.77	8.16	5.29	9.14	9.85
1949	13.46	10.28	7.72	3.44	3.94	8.74
1950	8.79	5.73	8.02	9.60	5.90	8.12
1951	5.14	-9.42	5.96	5.91	-12.06	6.19
1952	3.97	11.17	6.67	4.17	22.10	6.87
1953	6.60	6.67	5.64	6.39	5.78	5.59
1954	-7.35	-3.20	5.64	-22.02	-22.02	5.61
1955	-1.45	3.00	7.25	10.35	4.43	7.59
1956	21.98	19.64	8.11	23.94	30.07	9.41
1957	4.21	-10.11	5.64	4.45	4.14	5.59
1958	-1.15	15.84	6.73	-1.56	1.63	7.41
1959	4.13	4.10	6.35	4.03	-5.34	6.88
1960	-19.10	-13.89	7.56	-4.49	-9.99	8.22
1961	-0.75	16.32	9.34	-16.89	1.86	11.82
1962	-9.91	-10.62	8.46	-11.19	-6.49	10.22
1963	45.76	26.71	5.69	48.70	39.31	5.76
1964	0.23	2.97	7.43	3.35	3.43	6.76
1965	8.03	6.02	7.61	5.94	6.16	7.34
1966	3.71	3.57	6.11	3.88	3.88	5.60
1967	2.49	2.82	7.49	2.58	-4.96	7.29
1968	3.24	-16.40	5.73	3.24	10.31	5.61
1969	4.92	22.06	7.49	3.58	-1.18	7.84
1970	-17.82	-17.30	6.21	-19.41	-7.91	6.42
1971	24.89	24.89	6.04	25.73	22.52	5.70
1972	-13.86	-10.31	5.69	-13.29	-20.74	5.61
1973	19.00	15.59	6.85	17.55	17.01	7.07
1974	-1.96	-3.97	5.83	-3.09	-3.73	5.63
1975	13.20	11.04	5.64	15.70	23.22	5.59
1976	-39.12	-24.58	10.69	-47.92	-37.62	14.28
1977	-7.70	-17.19	17.77	0.00	-8.99	23.07
1978	13.74	22.62	11.81	7.14	16.48	13.10
Ave	3.61	3.86	8.44	3.32	3.62	9.35

Total Annual CCWD Delta Diversions (TAF)

Water Year	Existing level of development w/ORH4	w/ClCt	DESALT	Future level of development w/ORH4	w/ClCt	DESALT
1922	142.73	143.18	124.01	200.26	200.24	181.70
1923	114.95	107.72	123.41	169.13	152.02	180.55
1924	83.48	90.15	137.90	138.54	156.03	193.74
1925	148.98	148.96	136.17	196.24	196.24	197.54
1926	125.80	136.53	126.79	185.92	186.49	185.31
1927	149.88	139.24	125.27	211.55	215.26	182.72
1928	122.67	122.68	123.56	183.04	178.98	180.27
1929	108.46	118.45	134.76	142.17	152.56	193.02
1930	123.92	137.16	135.06	186.45	176.25	196.33
1931	100.88	90.44	138.71	170.91	171.82	198.44
1932	129.57	120.08	136.53	196.40	197.11	196.92
1933	122.12	120.81	140.04	172.24	171.31	198.19
1934	132.91	133.96	149.03	188.03	188.03	211.09
1935	160.86	155.21	135.51	208.37	208.05	196.39
1936	144.39	148.56	125.89	188.40	188.19	182.56
1937	119.05	119.69	125.41	175.90	175.99	183.15
1938	124.23	123.78	125.05	206.09	206.33	183.55
1939	105.51	97.61	134.18	159.63	171.49	190.61
1940	124.73	131.64	134.85	179.75	187.82	195.21
1941	129.80	142.59	124.87	191.89	184.30	181.90
1942	133.14	121.66	123.53	190.30	180.30	180.72
1943	121.89	121.88	123.38	178.95	169.95	180.50
1944	118.27	101.10	125.71	167.04	155.20	183.45
1945	127.15	116.95	125.25	156.16	163.96	184.27
1946	122.67	149.10	124.32	205.70	205.34	182.95
1947	98.02	106.73	125.19	186.10	197.40	182.72
1948	135.59	133.34	125.71	179.92	183.77	184.50
1949	131.03	127.85	125.28	178.07	178.57	183.39
1950	126.36	123.30	125.58	184.23	180.53	182.77
1951	122.71	108.15	123.52	180.54	162.57	180.84
1952	121.54	128.74	124.22	178.80	196.73	181.52
1953	124.17	124.24	123.20	181.02	180.41	180.24
1954	110.22	114.37	123.20	152.61	152.61	180.26
1955	116.12	120.57	124.81	184.98	179.06	182.24
1956	139.55	137.21	125.66	198.57	204.70	184.06
1957	121.78	107.46	123.20	179.08	178.77	180.24
1958	116.42	133.41	124.29	173.07	176.26	182.06
1959	121.70	121.67	123.91	178.66	169.29	181.53
1960	98.47	103.68	125.11	170.14	164.64	182.87
1961	116.82	133.89	126.90	157.74	176.49	186.47
1962	107.66	106.95	126.02	163.44	168.14	184.87
1963	163.33	144.28	123.25	223.33	213.94	180.41
1964	117.80	120.54	124.98	177.98	178.06	181.41
1965	125.60	123.59	125.17	180.57	180.79	181.99
1966	121.28	121.14	123.67	178.51	178.51	180.25
1967	120.06	120.39	125.05	177.21	169.67	181.94
1968	120.81	101.17	123.28	177.87	184.94	180.26
1969	122.49	139.63	125.05	178.21	173.45	182.49
1970	99.75	100.27	123.77	155.22	166.72	181.07
1971	142.46	142.46	123.60	200.36	197.15	180.35
1972	103.71	107.26	123.24	161.34	153.89	180.26
1973	136.57	133.16	124.41	192.18	191.64	181.72
1974	115.61	113.60	123.39	171.54	170.90	180.28
1975	130.77	128.61	123.20	190.33	197.85	180.24
1976	84.34	98.88	134.08	130.37	140.67	192.59
1977	122.97	113.48	148.38	156.32	147.33	179.46
1978	138.52	147.40	136.58	176.23	185.57	182.19
Ave	123.02	123.27	127.83	179.01	179.30	185.06

Section B-5. Fischer Delta Model Salinity Results for the Los Vaqueros Project Alternatives

EXISTING CONDITIONS
NO-ACTION SALINITIES

" Monthly Average Electrical Conductivity at Antioch"
" A7e Basecase Simulation, CCWD Dmds from JMM 10/90, 30 FDM µmhos/cm"

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	4517	4582	1532	540	263	222	264	199	194	464	1229	2779
1923	4173	1736	255	225	264	1037	738	379	501	1205	2147	3413
1924	4586	4270	3788	3413	2467	3060	4333	4994	5817	6799	7613	9523
1925	9454	7642	5666	4037	634	267	302	244	331	857	2380	4551
1926	5415	5207	4546	3168	537	598	682	844	1607	2752	4229	6114
1927	6585	2283	1052	454	261	246	233	230	252	460	1035	3035
1928	4189	1707	730	461	235	193	204	438	968	1151	1550	3277
1929	4017	3469	3641	3461	2320	2396	2552	3019	4687	5397	5440	6377
1930	6281	5646	4249	1389	996	440	442	925	1393	2408	3938	5461
1931	5615	5298	4302	3054	2900	3308	4001	4573	5543	6628	7476	9464
1932	9899	8344	3847	863	411	1138	1524	1283	1504	2366	3966	7013
1933	8547	7748	5269	3517	3057	2939	3469	4448	5676	6555	7494	9504
1934	9874	8282	5436	2833	2557	3689	4422	4884	5749	6501	7688	9607
1935	9958	7099	4544	924	312	260	212	205	306	783	2357	4792
1936	5595	5185	4383	863	268	233	278	242	311	726	1358	3190
1937	4301	3746	3745	3011	431	276	274	241	388	1179	2860	5237
1938	5857	1975	275	240	328	285	245	245	249	315	1111	1912
1939	514	279	990	2331	3225	3671	2928	3061	4824	4996	5211	6527
1940	6560	5399	4170	1017	320	268	236	240	360	772	1349	3231
1941	4413	3868	685	265	294	275	247	232	244	454	1109	3223
1942	2343	540	238	260	246	243	239	230	229	369	976	3200
1943	1815	354	240	252	247	235	236	235	258	473	1111	3107
1944	4806	4243	3641	2941	655	361	762	1086	1708	2630	4022	5972
1945	6391	3911	2122	2348	410	219	499	380	428	1169	2092	3886
1946	5178	3827	367	185	216	545	1011	448	353	725	1425	3173
1947	4105	3767	3642	3532	1849	879	1062	1255	1746	2632	3962	5762
1948	5830	5176	4332	3190	2859	1306	437	229	251	651	1353	2916
1949	3644	3345	3363	3027	2809	507	396	770	1518	2933	4359	5600
1950	5829	5394	4276	1364	259	275	570	357	416	1145	1832	2874
1951	4166	558	242	250	240	235	359	291	601	1061	1372	2951
1952	4119	3843	580	279	253	244	233	226	238	320	1209	1230
1953	312	283	241	237	236	367	434	253	231	385	1009	2681
1954	3290	769	767	468	195	190	192	205	317	706	1412	3053
1955	3829	3396	885	296	947	2031	1642	1228	1769	2529	3828	5210
1956	5408	4352	493	277	254	233	267	238	238	390	1016	2725
1957	866	309	1362	2689	742	201	325	290	391	1123	1804	2840
1958	1907	1051	384	255	293	273	240	228	236	337	947	2347
1959	716	333	1470	612	244	520	1101	1199	1750	2424	3346	4074
1960	4578	5162	4341	3058	836	347	620	999	1418	1893	3152	4970
1961	5465	4897	3899	3139	931	736	1052	1121	1705	2731	4290	5739
1962	5784	5443	4140	3155	492	252	538	543	556	1214	2218	3607
1963	846	274	247	364	256	247	234	227	248	463	1039	2861
1964	3553	910	1145	785	974	2069	1634	1276	1724	3003	4376	5648
1965	6142	4681	479	236	234	338	254	231	254	460	1018	3030
1966	4837	1265	337	221	200	223	569	1041	1436	1800	2475	4073
1967	4731	3917	717	294	270	239	241	230	250	278	1014	1392
1968	299	223	448	319	195	191	421	924	1385	1802	2486	3908
1969	4464	3822	1351	277	309	265	243	242	239	329	1141	1273
1970	356	246	232	271	247	232	323	781	1178	1242	1749	3425
1971	4590	1366	250	233	229	229	288	248	239	434	1032	2853
1972	2265	643	324	578	552	337	648	1042	1381	1885	2310	3349
1973	4032	1180	266	277	288	250	299	273	268	469	1300	3133
1974	4307	581	231	234	229	224	226	227	241	420	1028	2187
1975	871	242	291	1054	289	201	199	191	193	471	1316	2445
1976	735	243	645	1901	2620	3216	2923	3091	4826	5677	5384	5604
1977	5467	5204	5107	4835	4851	4684	4735	4794	5449	6378	7709	9483
1978	9796	9165	6356	687	285	274	261	238	257	437	1274	2779

" Monthly Average Electrical Conductivity at Emmaton"
" A7e Basecase Simulation, CCWD Dmds from JMM 10/90, 30 FDM µmhos/cm"

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	1176	1052	378	264	222	207	203	191	195	213	293	747
1923	960	376	209	218	209	297	235	220	225	279	452	859
1924	1099	884	835	745	531	847	1120	1358	1806	2100	3175	4419
1925	3506	2395	1367	953	230	208	204	203	207	249	628	1262
1926	1518	1540	1056	665	222	246	240	284	414	574	1223	1990
1927	1764	418	274	211	198	197	192	192	197	206	253	812
1928	915	373	245	222	197	191	195	226	286	268	329	925
1929	809	775	825	771	501	542	506	837	1366	1261	1522	2005
1930	1935	1593	861	329	320	212	217	294	359	498	1001	1559
1931	1651	1438	871	685	654	791	939	1310	1688	2052	3155	4332
1932	4091	2766	924	273	267	364	380	363	382	581	1335	2817
1933	3328	2463	1136	873	678	621	1029	1330	1621	2312	3102	4303
1934	4144	2782	1252	610	677	904	1324	1447	1745	2383	2871	4148
1935	4058	1909	1009	275	214	214	199	197	204	253	632	1463
1936	1482	1464	944	253	226	208	204	202	205	229	300	909
1937	908	762	847	761	244	232	216	205	216	285	761	1642
1938	1310	371	192	202	215	197	193	192	195	208	305	424
1939	225	198	292	558	793	863	681	846	1380	1049	1613	2136
1940	1914	1158	788	292	231	196	191	198	206	227	282	834
1941	888	747	226	202	202	196	192	191	196	205	265	886
1942	542	213	192	203	191	200	194	191	191	201	246	891
1943	512	205	196	201	196	194	195	195	197	206	267	830
1944	1230	858	799	665	249	220	255	331	428	524	1099	1934
1945	1810	873	488	544	211	211	233	215	221	274	432	1139
1946	1305	837	197	190	195	230	285	220	208	228	317	886
1947	854	851	824	784	424	257	289	349	441	520	1083	1827
1948	1520	1384	874	656	601	307	223	199	198	223	303	762
1949	730	694	725	656	616	207	219	262	394	637	1229	1677
1950	1645	1543	875	351	201	200	225	206	214	272	365	684
1951	845	204	194	201	194	196	207	200	236	251	287	717
1952	817	787	209	212	194	197	191	189	192	205	319	294
1953	197	197	195	193	194	208	213	193	191	201	259	664
1954	662	235	250	208	190	192	191	196	204	227	309	848
1955	763	734	258	225	302	433	352	352	448	487	1082	1480
1956	1183	847	205	199	193	194	199	191	195	203	251	672
1957	297	197	340	612	226	192	206	204	214	270	356	678
1958	369	265	204	209	201	197	192	191	193	202	253	511
1959	255	200	383	215	201	232	289	337	437	450	812	979
1960	1248	1318	867	666	255	210	229	311	370	366	840	1372
1961	1599	1240	788	724	259	259	269	328	435	560	1217	1657
1962	1716	1487	847	662	233	211	224	231	226	280	479	921
1963	230	195	193	228	195	203	190	191	195	205	252	751
1964	709	261	308	243	287	435	342	359	438	654	1167	1634
1965	1657	973	199	194	194	205	192	193	196	206	251	821
1966	1219	309	215	203	198	195	227	321	367	351	550	1102
1967	959	788	216	229	198	196	194	190	193	206	302	306
1968	201	195	217	206	191	194	221	301	358	351	572	1022
1969	895	785	307	204	206	199	194	192	196	216	310	285
1970	202	194	193	196	192	194	204	273	317	267	384	835
1971	965	308	196	193	193	191	200	193	193	203	251	715
1972	450	223	208	227	212	203	245	341	375	372	451	837
1973	853	288	195	212	205	197	205	200	199	207	321	764
1974	930	199	192	191	191	189	189	191	195	204	256	446
1975	263	195	204	294	199	194	196	191	193	212	310	522
1976	240	196	235	445	535	742	612	940	1467	1363	1504	1573
1977	1607	1580	1542	1465	1503	1705	1733	1693	2011	2339	2814	4209
1978	4611	3368	1429	241	210	204	196	196	200	210	315	593

" Monthly Average Electrical Conductivity at Jersey Point"
" A7e Basecase Simulation, CCWD Dmds from JMM 10/90, 30 FDM µmhos/cm"

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	1040	1209	474	242	239	209	197	177	182	212	354	612
1923	1069	527	214	218	205	272	357	210	196	344	582	800
1924	1221	1364	1173	999	705	687	1031	1239	1456	1824	2074	2991
1925	3115	2380	1786	1201	333	218	219	192	188	247	465	1001
1926	1377	1319	1270	950	291	237	254	232	325	671	1020	1571
1927	1740	746	317	270	220	209	191	189	194	214	317	609
1928	1108	526	254	212	191	179	186	194	239	353	442	705
1929	1202	1028	1027	966	635	595	757	684	1061	1536	1464	1718
1930	1652	1467	1354	759	362	279	214	241	301	582	923	1343
1931	1462	1403	1408	921	782	844	1041	1106	1343	1735	2004	2971
1932	3229	2624	1157	451	266	304	352	293	319	464	778	1754
1933	2616	2393	1830	1032	845	839	792	987	1411	1691	2034	3008
1934	3363	2719	1871	921	630	923	1038	1138	1423	1632	2113	3003
1935	3252	2306	1462	476	237	217	198	182	185	228	447	1059
1936	1461	1325	1280	427	262	226	203	190	186	250	412	687
1937	1187	1180	1096	747	286	269	236	191	191	323	596	1199
1938	1621	655	202	203	292	242	202	205	211	209	272	407
1939	215	176	249	509	737	924	747	648	1106	1542	1396	1785
1940	1721	1537	1329	483	278	225	193	192	199	262	420	674
1941	1159	1172	329	227	257	236	205	190	192	213	308	641
1942	511	227	192	222	204	200	195	187	189	203	307	633
1943	422	205	192	212	205	191	195	190	192	215	314	622
1944	1199	1340	1135	808	319	216	235	257	345	696	967	1515
1945	1744	1093	549	541	238	208	217	197	191	333	585	881
1946	1339	1047	221	173	177	205	264	205	188	252	396	679
1947	1174	1090	1002	964	505	280	284	288	351	695	963	1468
1948	1615	1367	1359	1013	829	715	324	194	182	237	396	646
1949	1066	1050	1056	898	776	256	195	220	307	678	1064	1457
1950	1520	1380	1316	468	205	200	227	196	189	334	595	723
1951	1093	263	201	209	197	193	202	195	210	327	427	630
1952	1083	1080	288	241	209	203	188	184	200	206	285	308
1953	194	189	195	196	192	198	212	195	190	206	302	557
1954	883	321	235	285	180	179	181	181	186	247	393	663
1955	1122	1037	362	214	273	535	519	307	354	696	931	1327
1956	1482	1330	279	238	212	195	201	194	196	208	308	558
1957	282	182	313	613	356	185	194	191	189	331	597	717
1958	561	319	216	218	255	229	195	185	198	208	282	516
1959	253	178	321	286	193	217	314	290	355	719	851	1016
1960	1075	1323	1405	933	437	245	252	255	298	523	695	1166
1961	1403	1328	1281	956	564	280	344	280	339	669	1017	1469
1962	1460	1405	1303	979	303	231	227	211	201	350	579	840
1963	342	191	192	225	205	207	190	185	190	214	324	587
1964	1038	365	289	380	285	553	559	330	353	705	1067	1439
1965	1557	1342	256	194	193	197	195	188	191	212	312	614
1966	1180	424	198	195	189	186	217	250	306	527	632	923
1967	1297	1176	345	263	226	197	198	188	214	212	259	340
1968	190	177	192	213	180	181	198	236	298	529	617	891
1969	1242	1104	466	230	270	221	202	199	200	214	277	346
1970	204	187	191	231	204	191	199	222	267	373	419	713
1971	1182	456	202	192	187	188	197	192	190	212	326	594
1972	610	262	197	208	257	240	229	250	287	503	700	815
1973	1015	407	205	241	246	206	199	195	196	214	309	637
1974	1048	276	189	192	187	181	183	185	192	208	306	540
1975	295	178	186	267	203	187	186	178	179	207	355	609
1976	283	174	204	409	692	844	804	657	1057	1578	1453	1480
1977	1417	1299	1257	1183	1169	1091	1088	1099	1271	1579	2113	2962
1978	3110	2874	2122	385	244	238	221	195	198	208	301	610

" Monthly Average Chlorides at Old River at Rock Slough"
" A7e Basecase Simulation, CCWD Dmds from JMM 10/90, 30 FDM mg/l"

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	78	102	61	32	55	38	21	25	41	21	25	43
1923	77	62	41	35	25	16	30	26	26	23	42	61
1924	88	110	98	82	58	52	78	102	121	153	184	261
1925	346	261	184	114	57	24	18	24	24	20	35	70
1926	111	118	108	84	43	19	19	19	27	43	76	122
1927	160	94	23	22	47	24	15	22	29	18	22	40
1928	84	59	23	17	16	24	15	20	26	25	33	49
1929	88	91	85	76	53	39	54	55	79	123	126	143
1930	155	134	122	88	43	27	16	20	27	38	70	107
1931	129	126	118	84	62	62	79	93	109	143	178	261
1932	342	293	156	51	41	31	28	27	29	37	67	134
1933	245	244	180	104	69	64	62	80	109	145	179	266
1934	352	293	195	89	56	70	84	97	116	145	186	269
1935	342	269	145	71	30	28	27	18	22	22	35	75
1936	127	122	113	59	65	33	16	22	24	19	28	49
1937	89	96	97	75	65	76	36	25	26	22	45	87
1938	136	75	22	23	62	34	40	30	19	29	26	31
1939	25	12	13	30	50	70	65	53	80	125	121	151
1940	161	137	113	74	60	60	20	24	26	19	29	47
1941	84	93	57	50	80	111	61	29	29	18	22	42
1942	52	21	26	44	43	19	21	28	28	18	21	42
1943	51	26	18	37	38	34	21	24	27	18	22	40
1944	85	108	95	70	49	24	15	22	28	44	73	116
1945	160	117	54	36	39	33	19	23	27	22	42	65
1946	109	96	40	13	14	15	17	24	25	19	28	47
1947	84	94	82	73	47	21	17	24	30	44	73	113
1948	150	128	118	86	66	74	40	24	19	17	27	45
1949	77	83	89	73	59	30	13	18	26	43	79	117
1950	136	128	117	58	20	14	15	18	22	22	43	57
1951	79	46	51	36	31	17	14	20	25	23	30	43
1952	77	92	44	52	45	41	25	36	60	28	24	27
1953	20	18	24	27	16	14	18	20	22	17	21	37
1954	63	34	14	20	14	14	14	20	23	19	28	46
1955	81	88	43	24	23	31	40	28	29	44	71	105
1956	123	115	55	77	69	17	18	36	42	20	21	39
1957	40	13	14	39	39	17	14	22	24	22	43	57
1958	47	22	19	31	77	71	89	37	52	23	21	33
1959	30	11	15	27	29	16	19	24	29	46	68	87
1960	89	108	121	87	51	24	18	23	29	35	55	89
1961	116	126	108	87	58	25	22	24	29	43	76	117
1962	131	134	116	85	67	33	16	20	23	23	42	62
1963	44	13	12	23	28	19	19	17	22	17	22	39
1964	75	46	15	30	17	32	42	31	30	45	80	113
1965	138	125	43	28	17	13	15	20	26	18	22	39
1966	84	62	25	21	21	13	14	24	29	35	50	68
1967	101	108	51	55	48	28	54	50	53	39	28	26
1968	24	15	16	22	24	18	15	21	28	35	52	67
1969	96	96	53	49	84	54	58	17	32	45	30	25
1970	23	18	24	66	40	21	15	22	29	26	33	48
1971	85	64	30	15	12	14	14	20	21	16	22	38
1972	47	21	19	12	15	18	18	29	33	34	52	66
1973	83	57	17	44	65	35	16	23	30	19	24	42
1974	78	48	24	28	20	18	14	21	28	18	22	34
1975	30	14	16	13	35	32	19	22	29	18	25	40
1976	30	12	10	17	42	61	66	59	82	126	129	129
1977	124	116	107	99	100	101	105	107	119	143	183	266
1978	331	314	230	88	52	63	56	29	38	24	24	39

" Monthly Average Chlorides at Rock Slough @ Contra Costa Canal"
" A7e Basecase Simulation, CCWD Dmds from JMM 10/90, 30 FDM mg/l"

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	79	102	76	85	128	55	34	31	46	28	29	45
1923	77	70	84	89	33	21	40	33	32	28	46	64
1924	87	110	102	87	67	61	85	106	122	155	185	248
1925	345	268	194	135	133	35	28	31	30	27	40	70
1926	111	120	113	96	115	28	31	25	32	47	80	120
1927	162	108	29	53	150	39	26	27	36	25	27	42
1928	84	67	30	41	21	55	26	26	31	31	38	51
1929	88	94	90	87	61	45	60	61	80	125	132	143
1930	158	137	127	112	71	38	25	26	32	43	74	107
1931	131	127	121	96	68	68	86	98	110	145	177	248
1932	341	298	188	85	95	43	39	33	35	43	71	125
1933	239	248	191	129	76	71	72	84	109	147	178	253
1934	350	301	207	105	93	74	94	102	117	148	185	258
1935	341	280	156	141	38	66	49	25	28	29	40	73
1936	127	124	118	99	225	53	25	28	30	25	33	50
1937	90	96	103	103	163	185	57	31	32	28	49	86
1938	136	86	32	60	215	98	58	32	20	35	33	34
1939	31	16	17	31	53	77	77	58	81	128	125	150
1940	165	140	117	136	182	102	34	29	32	25	33	49
1941	84	94	82	150	175	122	98	40	36	24	27	43
1942	58	25	35	130	80	30	43	34	35	24	25	43
1943	58	31	25	110	57	74	38	30	33	24	28	42
1944	83	109	100	79	113	37	26	29	33	48	77	114
1945	161	126	65	49	95	65	29	29	33	27	46	66
1946	109	102	55	30	19	23	25	30	31	25	33	49
1947	85	96	88	78	58	31	27	30	35	48	77	112
1948	153	131	121	92	71	85	55	32	26	23	32	47
1949	78	84	94	82	64	59	24	24	31	47	83	116
1950	138	131	122	86	39	22	23	24	28	27	46	60
1951	80	57	84	95	48	26	24	26	31	28	35	46
1952	77	94	67	174	63	83	45	41	62	38	31	31
1953	23	21	34	71	22	22	31	26	28	23	27	39
1954	64	41	18	24	21	24	24	26	30	24	33	48
1955	81	90	57	76	30	34	51	35	34	48	75	106
1956	125	118	111	171	104	30	30	41	49	27	26	42
1957	47	17	16	41	51	28	23	29	30	28	46	60
1958	53	25	26	94	234	148	112	54	54	31	26	36
1959	36	14	17	34	69	26	28	31	35	49	73	91
1960	91	106	124	99	90	35	27	29	34	40	60	88
1961	117	128	112	112	67	36	30	30	34	48	79	117
1962	134	136	122	94	195	51	23	26	29	28	47	64
1963	54	17	17	72	61	44	39	23	28	23	27	41
1964	75	56	18	50	22	36	50	38	36	49	83	113
1965	140	129	69	84	25	19	25	26	32	24	26	41
1966	83	73	34	58	33	19	22	29	35	40	56	70
1967	101	111	67	199	63	57	76	69	49	46	35	30
1968	27	19	21	40	36	31	26	27	33	40	59	68
1969	97	99	66	174	182	76	73	23	27	53	38	29
1970	27	21	32	181	64	32	26	28	35	32	39	50
1971	85	74	69	38	15	22	24	26	27	22	27	41
1972	51	25	27	20	19	23	28	35	40	39	56	69
1973	86	66	26	188	165	56	26	28	36	25	31	44
1974	79	59	46	75	27	34	25	26	34	25	27	36
1975	36	17	22	19	73	81	34	28	35	24	30	42
1976	37	15	13	17	43	68	76	66	84	128	135	131
1977	128	119	112	103	105	115	119	114	121	146	182	255
1978	318	315	244	212	108	127	88	39	44	32	31	42

" Monthly Average Chlorides at Old River at Highway 4"
" A7e Basecase Simulation, CCWD Dmds from JMM 10/90,   30 FDM   mg/l"

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	47	65	57	47	71	48	28	32	47	27	24	34
1923	51	54	56	54	37	20	29	32	34	25	32	43
1924	54	67	63	55	43	39	50	63	73	91	99	127
1925	193	160	119	78	66	31	20	29	33	24	32	48
1926	67	75	71	59	53	26	20	21	27	32	50	74
1927	96	77	26	27	68	34	21	30	38	24	23	32
1928	56	52	30	26	25	35	21	25	31	25	28	37
1929	55	64	62	53	40	30	37	39	51	73	81	87
1930	96	83	78	69	48	31	18	21	27	30	47	67
1931	80	79	75	59	46	41	48	58	67	85	94	127
1932	187	174	120	54	55	37	25	26	29	34	48	74
1933	131	143	115	78	52	44	45	54	65	80	94	129
1934	193	173	126	64	52	52	54	63	71	81	104	135
1935	189	168	100	75	42	42	39	24	27	27	33	51
1936	76	77	75	59	94	44	22	27	31	22	25	37
1937	57	59	67	64	81	100	46	33	33	24	36	57
1938	82	60	32	39	40	18	39	16	10	30	32	34
1939	33	20	20	28	39	47	47	41	51	74	77	91
1940	99	84	71	77	92	77	29	31	33	22	25	35
1941	55	60	60	76	104	65	54	38	39	23	23	35
1942	47	27	37	63	55	27	32	37	39	24	22	36
1943	49	34	28	53	48	42	30	32	34	23	23	32
1944	54	67	62	52	60	33	16	23	28	32	49	70
1945	94	87	50	33	50	46	25	29	34	23	32	45
1946	70	68	45	24	25	21	21	29	32	22	25	35
1947	53	65	61	49	41	23	18	23	29	33	49	69
1948	91	82	75	55	43	55	39	27	25	20	25	34
1949	50	53	60	52	42	32	18	21	27	32	51	71
1950	83	81	77	53	28	18	16	21	27	22	32	40
1951	52	49	55	52	41	24	19	26	31	24	26	33
1952	50	64	49	77	56	47	35	38	59	37	29	33
1953	29	25	36	44	26	21	23	26	30	22	22	30
1954	42	33	19	21	20	20	20	27	30	22	25	35
1955	52	60	42	38	31	24	31	26	29	33	48	65
1956	75	75	61	98	72	25	26	42	51	26	22	33
1957	45	19	16	32	41	26	18	25	32	24	32	40
1958	38	24	26	50	108	91	56	44	54	29	23	30
1959	36	17	18	32	44	23	18	23	28	33	46	60
1960	62	64	75	61	51	29	19	23	30	30	42	59
1961	71	83	72	63	47	26	20	22	29	34	51	72
1962	83	86	78	56	84	45	17	21	27	23	32	43
1963	43	19	17	35	42	27	25	22	28	21	22	31
1964	49	45	20	30	20	23	31	27	29	33	52	69
1965	85	85	47	42	26	18	20	27	33	23	22	31
1966	53	58	37	37	35	20	18	25	31	29	37	47
1967	64	77	55	84	64	40	51	52	26	42	33	30
1968	32	23	26	32	37	27	21	24	29	29	39	47
1969	60	66	50	71	54	60	48	7	21	46	37	28
1970	32	28	36	95	58	30	22	26	35	26	29	36
1971	53	61	47	26	21	22	19	25	28	20	22	29
1972	36	22	24	19	19	19	23	33	39	31	39	48
1973	58	58	27	71	88	46	21	28	39	25	26	35
1974	53	53	38	42	31	26	22	28	37	24	23	29
1975	34	22	23	18	44	45	29	30	38	24	24	32
1976	34	21	16	14	27	41	50	48	58	76	82	81
1977	79	75	71	63	62	70	78	77	78	85	103	132
1978	145	188	151	106	77	83	64	38	45	34	27	34

" Monthly Average Chlorides at Clifton Court"
" A7e Basecase Simulation, CCWD Dmds from JMM 10/90, 30 FDM mg/l"

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	43	56	55	52	67	45	32	42	47	27	24	36
1923	42	51	60	57	41	21	27	42	44	24	30	41
1924	45	51	51	44	37	39	47	56	69	79	99	117
1925	148	131	93	62	62	30	19	42	39	25	34	46
1926	60	69	61	49	53	26	18	24	33	31	47	66
1927	79	65	25	27	71	33	24	41	49	25	23	35
1928	45	48	31	28	29	41	22	37	36	24	26	38
1929	43	56	54	44	36	27	29	40	50	63	70	75
1930	78	68	59	58	45	29	17	25	31	29	43	58
1931	70	72	56	48	40	37	41	52	66	76	98	116
1932	142	140	101	49	58	37	27	31	33	38	62	79
1933	107	116	88	68	45	36	46	53	59	75	98	117
1934	153	140	98	51	51	48	51	59	66	82	97	118
1935	144	137	79	71	42	46	41	30	36	30	36	49
1936	66	68	60	55	87	43	22	38	37	22	23	38
1937	44	43	55	60	71	72	45	43	40	24	37	53
1938	63	51	34	45	25	14	32	13	9	36	35	37
1939	39	22	24	30	39	42	44	44	51	62	68	78
1940	80	66	52	73	89	66	31	41	37	22	24	36
1941	44	45	59	75	70	35	32	43	47	24	24	39
1942	48	29	43	65	51	29	36	45	47	25	22	41
1943	45	38	32	58	45	41	35	41	44	24	24	34
1944	49	52	50	46	64	33	16	31	32	29	45	62
1945	78	75	47	32	54	50	25	41	42	23	29	43
1946	60	58	49	29	32	23	23	40	39	22	24	35
1947	41	58	54	42	40	21	17	27	35	30	45	61
1948	77	73	56	39	33	45	34	33	30	20	23	34
1949	40	41	48	42	34	30	20	27	33	31	47	62
1950	70	71	59	48	29	17	15	29	32	22	27	37
1951	41	49	44	52	44	27	21	37	39	24	25	33
1952	39	54	48	75	45	40	37	38	38	38	32	36
1953	35	28	41	48	30	25	25	35	38	23	23	31
1954	33	31	19	20	21	21	21	38	35	22	24	35
1955	41	51	39	42	31	21	25	31	35	30	45	59
1956	62	57	58	63	43	27	30	46	50	27	22	36
1957	45	20	17	32	41	27	17	35	42	24	27	37
1958	32	23	28	53	96	65	28	45	41	29	23	31
1959	40	18	20	35	50	23	16	26	34	29	42	58
1960	57	54	54	48	48	27	17	27	36	28	42	54
1961	63	77	56	52	40	24	17	26	37	33	48	65
1962	70	78	60	42	85	43	15	27	32	22	30	41
1963	40	20	19	35	45	27	27	33	35	22	22	32
1964	39	44	21	29	18	19	24	29	33	32	47	62
1965	72	69	45	48	29	20	21	39	44	24	23	32
1966	46	58	42	41	39	21	18	35	35	26	34	44
1967	52	64	54	86	59	47	39	39	18	37	35	32
1968	37	25	31	36	43	32	22	31	34	26	37	45
1969	48	54	45	75	31	47	32	5	17	49	39	28
1970	39	33	41	67	51	37	24	40	42	26	29	35
1971	42	58	50	28	25	25	20	35	34	20	21	29
1972	30	21	25	20	21	18	25	46	48	30	33	47
1973	51	57	28	73	79	47	24	40	49	26	28	37
1974	46	54	43	48	36	31	26	39	47	26	23	27
1975	39	25	26	18	49	50	33	41	47	24	24	28
1976	36	24	18	12	21	37	44	55	61	66	72	73
1977	70	67	62	56	61	78	76	78	90	92	95	117
1978	122	144	113	100	76	70	39	43	57	39	30	35

" Monthly Average Chlorides at Tracy Pumping Plant"
" A7e Basecase Simulation, CCWD Dmds from JMM 10/90, 30 FDM mg/l"

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	69	79	69	68	66	44	50	58	46	47	50	58
1923	65	71	70	67	54	47	51	64	64	47	57	65
1924	72	75	72	69	65	66	72	78	89	90	108	122
1925	145	139	109	88	90	60	50	68	61	46	55	67
1926	82	89	82	74	82	56	51	53	61	53	68	82
1927	94	87	53	58	80	58	51	59	65	48	49	56
1928	69	69	55	56	53	59	46	63	56	49	54	60
1929	68	78	74	68	60	59	57	67	74	80	85	89
1930	92	88	82	83	72	59	47	52	56	51	63	78
1931	90	93	79	75	65	66	71	79	87	89	109	123
1932	140	137	111	74	78	64	59	61	57	60	84	100
1933	117	126	104	87	68	64	68	77	79	92	113	124
1934	152	145	114	76	75	75	73	82	85	96	108	124
1935	142	138	94	88	64	63	56	58	62	49	57	68
1936	86	88	80	75	84	62	46	63	59	47	51	60
1937	68	68	74	74	67	57	60	60	60	48	58	71
1938	81	72	58	59	24	13	30	13	9	47	55	49
1939	47	48	49	53	58	70	67	70	74	80	84	92
1940	94	89	75	89	118	61	46	55	55	46	49	58
1941	66	68	71	79	55	25	24	53	60	45	52	58
1942	57	53	56	71	50	50	49	56	59	45	47	54
1943	45	58	53	67	45	42	44	57	62	47	51	56
1944	66	74	72	68	75	59	49	65	54	54	66	80
1945	96	88	65	56	65	59	47	60	63	47	57	64
1946	74	73	59	49	48	49	45	61	61	46	53	59
1947	67	78	71	64	59	52	48	56	61	54	66	80
1948	97	92	79	67	63	70	61	67	59	46	52	59
1949	68	68	73	69	62	62	50	60	58	52	68	82
1950	88	90	81	73	57	48	45	61	55	47	53	63
1951	67	69	39	54	48	48	45	61	60	47	51	57
1952	66	74	68	77	41	37	41	38	33	52	53	48
1953	45	52	59	60	49	51	52	63	63	45	51	55
1954	60	58	48	51	51	51	46	62	56	47	53	59
1955	68	75	65	69	59	51	56	65	61	53	65	80
1956	83	79	86	50	33	46	50	50	49	46	49	59
1957	49	46	47	55	60	52	45	66	66	46	53	62
1958	60	51	53	73	89	53	19	49	37	47	51	55
1959	47	46	52	58	64	51	48	54	61	54	65	81
1960	78	78	78	74	73	56	46	57	63	52	62	72
1961	82	100	81	82	67	55	48	54	65	56	67	82
1962	85	97	81	69	94	66	46	57	57	47	56	64
1963	66	49	48	67	67	57	60	63	56	46	49	56
1964	67	70	50	60	52	52	53	55	59	53	68	81
1965	89	90	69	56	49	47	46	59	62	47	48	55
1966	65	70	57	58	55	47	44	61	56	51	59	67
1967	72	85	66	97	58	61	35	35	18	34	52	50
1968	43	49	51	58	61	59	51	60	56	51	62	68
1969	73	77	66	89	30	43	28	5	17	51	57	50
1970	49	51	54	56	49	55	49	63	63	48	52	60
1971	69	78	69	54	48	49	47	63	59	39	49	55
1972	58	51	54	50	50	47	47	63	67	53	57	66
1973	74	76	54	101	76	51	49	57	64	48	52	59
1974	69	71	60	57	48	51	44	54	62	48	49	53
1975	54	50	51	48	57	65	51	59	60	46	52	55
1976	58	50	46	48	57	68	59	71	78	80	87	89
1977	88	87	83	81	92	99	84	87	105	109	106	122
1978	120	144	126	112	86	64	29	51	67	61	52	58

" Monthly Average Electrical Conductivity at San Andreas Landing"
" A7e Basecase Simulation, CCWD Dmds from JMM 10/90, 30 FDM µmhos/cm"

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	291	332	227	219	228	195	179	163	174	176	189	226
1923	288	229	202	212	190	180	201	180	177	186	219	260
1924	309	347	328	295	248	248	300	340	379	450	546	820
1925	906	673	500	364	238	196	184	177	175	178	206	287
1926	361	366	349	295	216	190	182	180	188	223	289	406
1927	477	281	187	192	205	181	165	169	173	173	182	223
1928	297	228	185	184	176	169	174	177	180	188	201	241
1929	309	307	306	290	236	224	245	244	299	373	377	434
1930	451	403	372	325	236	196	179	180	186	214	279	361
1931	393	382	364	295	261	266	297	319	357	427	527	810
1932	933	753	406	258	231	208	194	187	188	205	265	479
1933	699	638	471	337	275	265	265	295	359	427	535	817
1934	938	736	501	298	267	288	306	328	372	424	545	805
1935	928	653	417	279	207	199	181	170	174	179	204	303
1936	394	376	357	241	258	202	180	175	175	178	195	240
1937	307	325	330	285	255	259	208	175	176	184	225	333
1938	411	249	172	187	272	214	175	181	192	179	182	193
1939	174	169	177	206	244	279	255	238	300	375	376	456
1940	475	412	363	283	260	205	169	170	173	176	194	236
1941	304	326	214	220	250	213	179	168	170	172	181	228
1942	214	174	171	207	183	174	168	163	167	170	180	228
1943	204	176	170	193	181	164	166	166	170	172	182	225
1944	308	342	323	268	231	191	180	183	190	226	282	389
1945	464	337	232	221	195	195	181	176	175	184	218	273
1946	352	308	173	165	169	174	178	175	175	178	194	238
1947	299	313	299	284	219	185	183	185	192	226	281	382
1948	438	388	366	303	268	301	226	175	172	176	193	232
1949	289	300	312	282	255	186	174	178	186	225	296	377
1950	413	390	362	230	181	178	177	173	174	184	221	248
1951	294	171	177	187	173	167	170	170	175	182	196	228
1952	289	316	192	223	182	179	158	161	184	176	182	182
1953	164	170	175	181	169	171	174	171	172	172	180	214
1954	255	189	175	186	170	169	170	173	175	178	193	234
1955	297	304	203	205	199	210	215	191	192	225	278	349
1956	389	363	207	219	188	170	175	173	175	173	181	215
1957	185	168	178	221	207	171	174	175	176	185	222	250
1958	218	182	174	203	258	203	163	158	185	175	179	205
1959	178	168	182	189	187	182	186	187	192	228	267	299
1960	314	358	371	302	241	198	183	183	187	205	243	321
1961	370	372	345	312	260	197	190	186	190	223	289	376
1962	401	398	361	300	252	210	180	177	177	186	218	263
1963	200	168	168	205	181	183	164	164	169	172	182	220
1964	285	203	180	210	188	211	219	195	192	227	294	370
1965	426	379	173	174	166	170	167	165	168	172	181	222
1966	308	216	181	188	181	173	176	182	187	207	232	277
1967	342	349	210	262	203	174	169	162	195	181	183	185
1968	169	170	174	186	173	171	175	180	186	207	233	274
1969	331	326	221	212	244	190	175	174	179	186	186	184
1970	168	168	172	216	179	166	170	177	182	187	198	238
1971	306	223	179	171	166	165	169	170	169	171	182	219
1972	219	179	179	174	179	185	182	185	189	203	237	266
1973	302	216	175	234	224	178	169	170	173	173	183	225
1974	293	191	168	173	164	156	156	165	170	172	181	207
1975	183	169	176	177	183	173	171	168	170	174	188	218
1976	183	168	171	186	229	265	262	245	301	377	380	390
1977	383	364	354	340	339	338	339	337	362	420	540	809
1978	947	875	608	288	222	226	198	172	177	175	183	217

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" Monthly Average Chlorides at Middle R. at Woodward Island"
" A7e Basecase Simulation, CCWD Dmds from JMM 10/90, 30 FDM mg/l "

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	30	42	47	50	68	45	28	33	44	25	22	30
1923	34	43	56	55	39	22	26	31	33	23	25	33
1924	33	35	37	33	28	30	34	38	47	55	68	88
1925	107	90	66	46	58	31	18	29	32	22	28	37
1926	42	49	45	37	49	27	17	18	24	25	35	49
1927	58	53	25	28	69	33	22	32	38	24	21	29
1928	36	41	31	29	30	36	22	26	29	21	23	30
1929	32	44	44	34	28	22	22	27	35	43	49	53
1930	55	47	42	49	44	29	17	19	24	24	33	44
1931	49	50	39	36	32	27	28	35	44	53	66	87
1932	105	99	79	47	56	35	21	23	26	29	41	58
1933	76	76	58	53	37	28	32	37	41	50	65	88
1934	107	90	65	36	45	39	34	41	45	55	68	86
1935	104	95	59	64	44	46	40	23	26	26	31	40
1936	47	48	45	49	87	41	23	28	30	21	21	31
1937	33	31	43	51	74	89	41	33	31	22	30	43
1938	46	40	34	44	62	29	39	23	16	29	31	35
1939	34	22	24	27	32	32	31	30	36	41	47	56
1940	58	46	37	67	95	72	29	32	31	20	20	28
1941	34	34	54	78	98	79	47	34	38	23	22	32
1942	41	28	42	62	51	27	34	37	39	23	20	35
1943	44	36	32	53	45	36	28	32	33	22	22	29
1944	37	36	36	36	58	33	15	21	25	23	33	45
1945	54	60	41	29	49	47	25	30	33	21	25	34
1946	47	45	40	27	29	23	22	29	31	20	22	29
1947	30	45	43	32	32	21	15	20	25	24	33	44
1948	54	53	40	27	24	37	31	24	24	19	21	28
1949	31	30	36	32	27	26	18	20	24	25	35	45
1950	49	51	43	40	29	18	14	19	25	20	23	29
1951	32	43	48	47	41	25	20	27	30	22	21	27
1952	30	44	43	73	49	41	31	34	47	32	28	34
1953	31	27	41	46	29	24	23	26	31	22	21	26
1954	26	28	21	21	23	23	22	28	29	20	22	29
1955	31	39	34	41	33	19	19	21	25	24	33	42
1956	45	42	51	91	61	24	28	42	46	25	20	30
1957	43	20	18	28	37	27	17	24	32	22	22	28
1958	27	23	28	55	106	77	55	35	47	26	22	28
1959	35	19	19	33	47	24	15	19	24	23	31	44
1960	45	38	37	37	43	28	16	20	27	25	33	43
1961	43	56	41	40	34	22	16	19	25	27	36	48
1962	51	58	45	30	80	44	15	18	25	21	25	32
1963	35	21	20	38	45	28	24	22	28	20	20	26
1964	31	38	22	28	19	17	18	20	24	25	34	44
1965	53	54	37	40	27	20	21	29	32	22	21	27
1966	36	50	40	40	39	22	19	24	28	23	27	35
1967	40	52	49	87	63	41	46	40	41	39	31	30
1968	34	25	30	36	40	28	21	22	27	23	30	36
1969	36	43	40	68	76	54	42	11	32	43	35	27
1970	34	31	40	87	51	31	21	26	33	23	24	29
1971	32	52	48	29	26	25	20	26	28	19	19	24
1972	25	20	26	21	21	19	24	33	37	27	28	37
1973	41	52	29	75	81	43	20	30	37	24	24	31
1974	38	48	40	42	33	28	23	30	37	24	22	25
1975	33	25	26	19	44	42	29	32	38	23	22	25
1976	32	25	18	12	16	27	35	38	45	46	50	52
1977	48	47	43	38	40	52	60	57	60	61	66	87
1978	106	109	82	94	79	79	55	33	42	33	27	32

EXISTING CONDITIONS
LOS VAQUEROS RESERVOIR WITH AN OLD RIVER AT HIGHWAY 4 INTAKE
PROJECT ALTERNATIVE AND NO-ACTION COMPARISON

NOTE: OLD RIVER AT ROCK SLOUGH
CLIFTON COURT FOREBAY
TRACY PUMP PLANT
SAN JOAQUIN RIVER AT SAN ANDREAS LANDING
HAD NO CHANGES MEETING THE SCREENING CRITERIA

Difference in Electrical Conductivity at Antioch
Changes which meet screening criteria
Rock Slough/Old River Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924							47					
1925												
1926												
1927			-91	-27								
1928												
1929							9					
1930												
1931							1					
1932				-44								
1933												
1934							5					
1935												
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944												
1945												
1946												
1947												
1948												
1949												
1950												
1951												
1952												
1953												
1954												
1955							1					
1956												
1957												
1958												
1959												
1960												
1961												
1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976							1					
1977												
1978												

Decreases = 3 No Change = 681 Increases = 0
Differences with base near D1485: Increases = 6 Decreases or No Change = 4

Difference in Electrical Conductivity at Emmaton
Changes which meet screening criteria
Rock Slough/Old River Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930												
1931												
1932												
1933												
1934												
1935											1	
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944												
1945												
1946												
1947												
1948												
1949												
1950												
1951												
1952												
1953												
1954												
1955												
1956												
1957												
1958												
1959									1			
1960												
1961									3			
1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977											1	
1978												

Decreases = 0 No Change = 684 Increases = 0
Differences with base near D1485: Increases = 4 Decreases or No Change = 10

Difference in Electrical Conductivity at Jersey Point
Changes which meet screening criteria
Rock Slough/Old River Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924						36						
1925												
1926												
1927												
1928												
1929												
1930												
1931												
1932												
1933												
1934											7	
1935											1	
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944												
1945												
1946												
1947												
1948												
1949												
1950												
1951												
1952												
1953												
1954												
1955												
1956												
1957												
1958												
1959												
1960												
1961												
1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977											2	
1978												

Decreases = 0 No Change = 683 Increases = 1
Differences with base near D1485: Increases = 3 Decreases or No Change = 6

Difference in Chlorides at Rock Slough @ Contra Costa Canal
Changes which meet screening criteria
Rock Slough/Old River Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	-7	-9	14	94	130	108				9		
1923	-13		17	108	156	35						
1924	-8	-8	7	13								-23
1925	-34	47	42	72	122	196	6					-7
1926	-11		6	22	40	124		6				-11
1927	-10	42			84	93						
1928	-18	8	8	19	68	26	7					
1929	-13			12	6							
1930		15	7	33	71							
1931		7	8	24	43	14						-26
1932	-21	35	103	154	96	124	13	7				-18
1933	-42	12	34	58	88	27	7					-24
1934	-24	46	55	83	44	72						-21
1935		49	70	60	189	20	7					-9
1936	-18	8	6	43		116						
1937	-15			19	31	129	100					-10
1938	-12	25		35		213	43					
1939	6					-9	10	9				-9
1940		15	11	15	89	230	49					
1941	-12		20	15	119	185	111					
1942	6			43	167	141	9					
1943	6			37	156	86	15					
1944	-17	-9	7	11	56	64						-9
1945	-11	26	17	20	61	81	10					
1946	-17	12	12	20	37							
1947	-13		6	13								-7
1948	-9	15		27	27							
1949	-13			16	30							-6
1950				28								
1951	-8		-7	63	149	17						
1952	-12	-6	8	41	184	43	17			13		7
1953				44	33							
1954	-7											
1955	-11			51	135	31		11				
1956		6	35	63	160	30				7		
1957	7			-6								
1958	12			21		177	174	50		11		
1959	8				6	17						
1960	8	-6		25	50	70	10					
1961			12	19	45							-6
1962			10	27	12	120						
1963	18			25	50	25	45					
1964	-15				61			8				
1965		8	19	49	148	37						
1966	-17	16		36	105	11						
1967	-8		20	42	181	7	10	18		6		6
1968				6	32							
1969	-8		12	66	151	183	8				6	7
1970				13	157	7						
1971	-12	17	10									
1972				13								
1973		15		127	209	183	13					
1974	-14	7	16	44	24							
1975	10				-10	45	15					
1976	12				-13	-8	7	7				7
1977	10	8	7	9			9	9				-20
1978		17	52	50	218	203	143			8		

Decreases = 57 No Change = 392 Increases = 235
Differences with base near D1485: Increases = 7 Decreases or No Change = 11

Difference in Chlorides at Old River at Highway 4
Changes which meet screening criteria
Rock Slough/Old River Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924											7	
1925												
1926												
1927												
1928												
1929												
1930												
1931											6	9
1932												
1933											7	9
1934										6		8
1935												
1936												
1937												
1938					-6							
1939												
1940												
1941												
1942												
1943												
1944												
1945												
1946												
1947												
1948												
1949												
1950												
1951												
1952												
1953												
1954												
1955												
1956												
1957												
1958												
1959												
1960												
1961												
1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969					-6							
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977												8
1978	15											

Decreases = 2 No Change = 673 Increases = 9
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Middle R. at Woodward Island
Changes which meet screening criteria
Rock Slough/Old River Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930												
1931												
1932												
1933												
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1951												
1952												
1953												
1954												
1955												
1956				6								
1957												
1958												
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1962												
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1964												
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977												
1978												

Decreases = 0 No Change = 683 Increases = 1
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

EXISTING CONDITIONS
LOS VAQUEROS RESERVOIR WITH A CLIFTON COURT FOREBAY INTAKE
PROJECT ALTERNATIVE AND NO-ACTION COMPARISON

NOTE: CLIFTON COURT FOREBAY
TRACY PUMP PLANT
SAN JOAQUIN RIVER AT SAN ANDREAS LANDING
HAD NO CHANGES MEETING THE SCREENING CRITERIA

Difference in Electrical Conductivity at Antioch
Changes which meet screening criteria
Rock Slough/Clifton Court Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924							48					
1925												
1926												
1927			-69									
1928												
1929							7					
1930												
1931												
1932												
1933												
1934							11					
1935												
1936												
1937												
1938												
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1955							1					
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1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976							1					
1977												
1978												

Decreases = 1 No Change = 683 Increases = 0
Differences with base near D1485: Increases = 5 Decreases or No Change = 5

Difference in Electrical Conductivity at Emmaton
Changes which meet screening criteria
Rock Slough/Clifton Court Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924											7	
1925												
1926												
1927												
1928												
1929												
1930												
1931											9	
1932												
1933											11	
1934												
1935											1	
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944												
1945												
1946		-57										
1947									2			
1948												
1949												
1950												
1951												
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1954												
1955												
1956												
1957												
1958												
1959									1			
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1961									11			
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1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977											19	
1978												

Decreases = 1 No Change = 683 Increases = 0
Differences with base near D1485: Increases = 8 Decreases or No Change = 6

Difference in Electrical Conductivity at Jersey Point
Changes which meet screening criteria
Rock Slough/Clifton Court Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924						37						
1925												
1926												
1927												
1928												
1929												
1930												
1931												
1932												
1933												
1934											1	
1935											1	
1936												
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1955							1					
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1961										45		
1962												
1963												
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1965												
1966												
1967												
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1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977											14	
1978												

Decreases = 0 No Change = 682 Increases = 2
Differences with base near D1485: Increases = 4 Decreases or No Change = 5

Difference in Chlorides at Old River at Rock Slough
Changes which meet screening criteria
Rock Slough/Clifton Court Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930												
1931												
1932												
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1952												
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1954												
1955												
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1958												
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1960												
1961												6
1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969					6							
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977												
1978												

Decreases = 0 No Change = 682 Increases = 2
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Rock Slough @ Contra Costa Canal
Changes which meet screening criteria
Rock Slough/Clifton Court Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	-7	-9	14	102	133	77				8		
1923	-13	9	22	110	156	34						
1924	-8	-8	7	14								-21
1925	-31	48	42	72	122	196	6					-8
1926	-12		6	11	107	152		6				-11
1927	-10	39			33	73						
1928	-18	7	10	20	70	27	8					
1929	-13			13	6			6			7	
1930		15	7	34	60							
1931			7	23	43	13						-23
1932	-25	36	105	130	86	119	13	7				-18
1933	-42	12	34	58	88	27	7					-23
1934	-23	46	55	57	29	67						-22
1935		50	70	60	189	47	17					-9
1936	-17	9	6	43		120						
1937	-15			18	30	128	99					-10
1938	-12	21	6	28	-15	206	41					
1939						-9	10	9				
1940		15	12	17	90	230	52					
1941	-12		30	17	117	91	7					
1942	10			43	167	142	7					
1943	6			37	156	86	15					
1944	-17	-9	7	10	9	50						-8
1945	-9	27	14	21	69	105	12					
1946	-17	12	14									
1947	-13		6	12								-7
1948	-9	16		27	27							
1949	-13			17	30		15					-6
1950			7	25	6	27						
1951	-8	11	-6	62	148	22						
1952	-12	-6	9	43	106		8			14		
1953				44	35							
1954	-7											
1955	-11			49	137	30		11				
1956		8	36	63	79					7		
1957	11			-8								
1958	12			39	26	196	178	30		10		
1959	10				10	12					6	
1960	9			26	62	87	12					
1961			11	18	20							
1962	8		11	28	27	125						
1963	18			13	100	122	95	7				
1964	-14	6	12	7	63			8				
1965		9	20	34	127	34						
1966	-17	18		36	106	10						
1967	-8		19	39	184	39	20	6				6
1968					32							
1969	-8		7	46	177	101					6	7
1970				13	181	20						
1971	-12	19	22									
1972				13								
1973		20		98	194	163	16					
1974	-14	11	14	48	28							
1975	12				-10	45	16					
1976	12				-18	-8	7	7				9
1977	11	9	7	9			9	9				-18
1978		21	54	51	218	204	62					

Decreases = 55 No Change = 389 Increases = 240
Differences with base near D1485: Increases = 7 Decreases or No Change = 11

Difference in Chlorides at Old River at Highway 4
Changes which meet screening criteria
Rock Slough/Clifton Court Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924											8	7
1925												
1926												
1927												
1928												
1929												
1930												
1931											8	10
1932	10											
1933										6	9	12
1934	12									6	6	10
1935	10											
1936												
1937												
1938												
1939												
1940												
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1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977										6	8	11
1978	19	10										

Decreases = 0 No Change = 666 Increases = 18
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Middle R. at Woodward Island
Changes which meet screening criteria
Rock Slough/Clifton Court Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
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1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977												
1978	6											

Decreases = 0 No Change = 683 Increases = 1
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

EXISTING CONDITIONS
DESALINATION PROJECT ALTERNATIVE AND NO-ACTION COMPARISON

NOTE: OLD RIVER AT ROCK SLOUGH
OLD RIVER AT HIGHWAY 4
CLIFTON COURT FOREBAY
TRACY PUMPING PLANT
SAN JOAQUIN RIVER AT SAN ANDREAS LANDING
MIDDLE RIVER AT WOODWARD ISLAND
HAD NO CHANGES MEETING THE SCREENING CRITERIA

Difference in Electrical Conductivity at Antioch
Changes which meet screening criteria
Desalination Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930												
1931												
1932							11					
1933												
1934							5					
1935												
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1954												
1955							6					
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1964												
1965												
1966												
1967												
1968												
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1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977							6					
1978												

Decreases = 0 No Change = 684 Increases = 0
Differences with base near D1485: Increases = 4 Decreases or No Change = 6

Difference in Electrical Conductivity at Emmaton
Changes which meet screening criteria
Desalination Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930												
1931											10	
1932												
1933											2	
1934												
1935												
1936												
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1961									1			
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1963												
1964												
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977											8	
1978												

Decreases = 0 No Change = 684 Increases = 0
Differences with base near D1485: Increases = 4 Decreases or No Change = 10

Difference in Electrical Conductivity at Jersey Point
Changes which meet screening criteria
Desalination Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930											5	
1931												
1932												
1933												
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1952												
1953												
1954												
1955							2					
1956												
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1965												
1966												
1967												
1968												
1969												
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1971												
1972												
1973												
1974												
1975												
1976												
1977											11	
1978												

Decreases = 0 No Change = 684 Increases = 0
Differences with base near D1485: Increases = 3 Decreases or No Change = 6

Difference in Chlorides at Rock Slough @ Contra Costa Canal
Changes which meet screening criteria
Desalination Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												2
1925												
1926												
1927												
1928												
1929												
1930												
1931												2
1932	1											
1933												
1934												
1935												
1936					-13							
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944												
1945												
1946												
1947												
1948												
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1955												
1956												
1957												
1958					-13							
1959												
1960												
1961												
1962												
1963												
1964												
1965												
1966												
1967				-12								
1968												
1969												
1970												
1971												
1972												
1973				-11								
1974												
1975												
1976												
1977												1
1978												

Decreases = 4 No Change = 680 Increases = 0
Differences with base near D1485: Increases = 4 Decreases or No Change = 14

EXISTING CONDITIONS
MIDDLE RIVER AT WOODWARD ISLAND INTAKE PROJECT ALTERNATIVE
AND NO-ACTION COMPARISON

NOTE: TRACY PUMPING PLANT
SAN JOAQUIN RIVER AT SAN ANDREAS LANDING
HAD NO CHANGES MEETING THE SCREENING CRITERIA

Difference in Electrical Conductivity at Antioch
Changes which meet screening criteria
Middle River Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929							1					
1930												
1931							1					
1932												
1933												
1934							1					
1935												
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1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977							2					
1978												

Decreases = 0 No Change = 684 Increases = 0
Differences with base near D1485: Increases = 4 Decreases or No Change = 6

Difference in Electrical Conductivity at Emmaton
Changes which meet screening criteria
Middle River Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924											4	
1925												
1926												
1927												
1928												
1929												
1930												
1931											4	
1932											1	
1933											3	
1934											4	
1935											1	
1936												
1937												
1938												
1939												
1940												
1941												
1942												
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1959									1			
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1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977											3	
1978												

Decreases = 0 No Change = 684 Increases = 0
Differences with base near D1485: Increases = 8 Decreases or No Change = 6

Difference in Electrical Conductivity at Jersey Point
Changes which meet screening criteria
Middle River Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930												
1931												
1932											1	
1933												
1934											6	
1935											1	
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1972												
1973												
1974												
1975												
1976												
1977											4	
1978												

Decreases = 0 No Change = 684 Increases = 0
Differences with base near D1485: Increases = 4 Decreases or No Change = 5

Difference in Chlorides at Old River at Rock Slough
Changes which meet screening criteria
Middle River Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930												
1931												
1932												
1933											9	
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1975												
1976												
1977												
1978												

Decreases = 0 No Change = 683 Increases = 1
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Rock Slough @ Contra Costa Canal
Changes which meet screening criteria
Middle River Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	-6	-9	25	33	98	146	24			9		
1923	-13	14	14	103	154	34		9				
1924	-8	-7	8	14	21	9						-15
1925	-26	56	49	76	123	196	42	7	6			-7
1926	-10		7	22	36	124	12	9				-8
1927		46	37	13	26	171	35					
1928	-17	19	20	22	72	27	42					
1929	-12			13	43	23		6			8	
1930	8	19	9	34	114	114	34					
1931		7	8	25	44	14						-20
1932	-18	41	107	176	178	153	14	7				-16
1933	-40	15	36	60	90	27	8					-20
1934	-20	51	55	87	91	79		6				-18
1935		56	73	62	190	76	107	31				-9
1936	-17	10	7	41		214	35					
1937	-15			19	31	129	140	7				-10
1938	-12	41	26	27		217	122	23				
1939	7	10			-14	-18	10	9			9	
1940		21	15	17	90	230	124					
1941	-13		21	16	119	184	113	47				
1942	6	17		42	166	141	49	23				
1943	6	12		37	156	86	67	8				
1944	-17	-8	8	20	21	106	13					-8
1945	-9	29	36	36	57	146	66					
1946	-17	13	39	49	50	12						
1947	-13		7	14	31	32	8					-8
1948	-10	17	8	29	28		27	14				
1949	-11			17	30	30	32					
1950		9	8	45	95	67	9					
1951	-7	24	-14	54	146	80	11					
1952	-12		32	-14	176	84	77			14		7
1953				44	114	22		7				
1954	-6	21	8									
1955	-11		26	26	131	29		11				
1956		9	37	64	160	95	6			9		
1957	8	19		-9	-9	14	7					
1958	12	15		38	26	196	178	72		12		
1959	8	14			9	67						
1960	9			27	49	88	12					
1961			13	20	73	41	8					
1962			12	29	-26	174	25					
1963	19	18		39	124	131	94	25				
1964	-14	20	15		61			9				
1965		11	62	68	151	40						
1966	-16	19	20	19	93	43						
1967	-7		40	-42	171	81	37	22	13	8	6	6
1968					32	24	10					
1969	-7		27	-53	84	165	18	28		6	6	7
1970				13	193	98	15					
1971	-12	18	31	117	97	17						
1972		15		14	13							
1973		20	42	-63	116	235	66					
1974	-13	22	21	43	113	34	23					
1975	10	9		11	-9	56	69					
1976	13	11			-18	-8	8	7			9	9
1977	11	10	8	10			11	10				-18
1978		21	55	52	219	203	146	31		8		

Decreases = 58 No Change = 309 Increases = 317
Differences with base near D1485: Increases = 7 Decreases or No Change = 11

Difference in Chlorides at Old River at Highway 4
Changes which meet screening criteria
Middle River Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924										6	11	13
1925	10											
1926												
1927												
1928												
1929												
1930												
1931										6	10	13
1932	15											
1933	8									8	11	13
1934	16									8	8	12
1935	15											
1936												
1937												
1938												
1939												
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1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977										7	8	11
1978	20	12										

Decreases = 0 No Change = 662 Increases = 22
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Clifton Court
Changes which meet screening criteria
Middle River Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												7
1925												
1926												
1927												
1928												
1929												
1930												
1931												7
1932	9											
1933											6	7
1934	9											6
1935	8											
1936												
1937												
1938												
1939												
1940												
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1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977												6
1978												

Decreases = 0 No Change = 675 Increases = 9
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Middle R. at Woodward Island
Changes which meet screening criteria
Middle River Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930												
1931												
1932												
1933												
1934												
1935												
1936												
1937												
1938					-12							
1939												
1940												
1941												
1942												
1943												
1944												
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1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969					-6							
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977												
1978	6											

Decreases = 2 No Change = 681 Increases = 1
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

FUTURE CONDITIONS
NO-ACTION SALINITIES

" Monthly Average Electrical Conductivity at Antioch"
" 543b Basecase Simulation, CCWD at buildout, (JMM 10/90), 4J FDM µmhos/cm"

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	4447	4852	1626	532	262	219	326	210	194	513	1202	2359
1923	3789	2579	364	224	261	982	713	396	515	1254	2051	2805
1924	3743	4347	3764	3568	2742	3188	4216	4731	5656	6566	7605	9475
1925	9695	8100	5806	4860	828	268	286	266	354	743	2090	4409
1926	5434	5204	4977	3944	704	620	635	790	1621	2368	3063	4633
1927	5634	2259	1655	916	281	248	233	231	255	462	939	2059
1928	3435	2219	1461	856	309	195	196	466	1016	1189	1405	2406
1929	3693	4090	3560	3565	2894	3001	3893	4633	5651	5203	5818	8294
1930	8774	8641	6629	1902	1205	512	488	957	1399	1798	2518	3892
1931	4662	4801	5039	4542	4614	4924	5161	5177	5821	6691	7671	9500
1932	9601	8642	4815	1199	470	1201	1536	1235	1461	1840	3229	5764
1933	6162	5444	5184	4630	4540	3901	3664	4490	5702	6778	7662	9397
1934	9414	8635	6342	3962	3341	3986	4587	4964	5883	6883	7768	9390
1935	9461	7305	6249	1482	337	266	212	220	337	756	1282	2447
1936	3844	4645	4991	1219	279	234	275	284	354	782	1307	2156
1937	3449	3858	3712	2287	349	270	261	332	503	1253	3117	5866
1938	6778	2578	349	244	336	294	247	245	253	324	1086	2298
1939	951	540	1680	3279	3842	4004	3145	3124	4843	4514	3773	4539
1940	5244	4858	4333	1069	327	268	234	248	374	828	1250	2170
1941	3540	3825	693	263	290	268	243	231	243	449	995	2398
1942	2819	2526	453	260	243	238	238	229	227	371	969	2794
1943	2660	1467	381	250	242	235	236	250	273	473	981	2163
1944	3463	3618	3234	1718	377	292	578	1004	1687	2579	4301	6662
1945	6844	4611	3108	3107	481	221	453	512	529	1293	2440	4350
1946	5488	4675	496	186	217	726	1172	493	375	777	1307	2361
1947	3660	4140	3645	3104	1800	864	955	1180	1727	2428	3369	5252
1948	5739	5156	5166	4047	3928	1654	357	215	291	716	1233	2376
1949	3778	4624	4839	4692	4197	687	401	889	1625	2362	2780	3669
1950	4618	4942	5010	2273	383	284	565	526	532	1211	2246	3207
1951	4098	644	235	246	239	235	347	363	756	1183	1288	2151
1952	3605	4101	646	277	249	242	232	226	234	329	1170	1394
1953	488	362	248	235	237	372	456	264	234	396	927	2086
1954	3169	2359	2404	881	216	190	192	216	339	725	1239	2212
1955	3542	3600	960	328	949	2047	1734	1290	1805	2450	3312	4680
1956	5586	5467	592	275	247	231	269	237	235	392	909	2134
1957	802	1218	3122	3272	786	206	322	365	474	1165	1760	2332
1958	2098	1638	658	268	289	275	243	229	232	338	959	2246
1959	902	906	2481	781	248	520	1143	1223	1767	2433	2999	3412
1960	4052	3837	3293	2533	622	256	565	995	1445	1863	3207	5162
1961	5542	4924	3789	3363	1120	1024	1404	1232	1767	2419	3786	5528
1962	5750	5381	3979	3690	651	266	585	540	536	1176	2169	3693
1963	1023	790	593	966	324	246	234	227	250	468	939	1974
1964	3177	1324	1631	1002	1015	2020	1822	1387	1752	2403	2895	3686
1965	4734	4235	489	234	231	335	252	236	261	469	978	2213
1966	3374	1212	707	321	203	242	633	1044	1435	1811	2315	3047
1967	4071	3781	695	297	270	238	240	227	245	311	959	1467
1968	394	256	649	429	198	190	416	914	1389	1814	2151	2834
1969	4034	3932	1172	274	300	260	240	239	235	343	1024	1472
1970	580	280	233	267	246	232	321	778	1190	1239	1503	2472
1971	3829	2018	287	234	235	231	301	259	257	479	982	2183
1972	1884	2295	1299	485	393	412	754	1075	1406	1818	2025	2758
1973	3581	1445	443	285	284	248	296	323	292	485	961	2098
1974	3557	780	234	233	228	223	225	227	256	460	925	2036
1975	1834	792	479	412	211	198	201	193	205	559	1207	2287
1976	974	365	763	2242	3363	3431	3528	4163	5561	5202	5616	7462
1977	7876	8099	6662	5191	5126	4674	4657	4727	5423	6312	7475	9391
1978	9794	9101	6320	724	294	304	289	257	267	432	1082	2330

" Monthly Average Electrical Conductivity at Emmaton"
" 543b Basecase Simulation, CCWD at buildout, (JMM 10/90), 4J FDM µmhos/cm"

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	1172	1204	377	257	222	204	212	192	195	217	278	518
1923	909	523	218	217	210	281	233	224	227	285	404	605
1924	1038	1010	756	873	542	859	1363	1593	1890	2279	2993	3940
1925	3620	2552	1398	1372	243	209	203	206	208	230	517	1280
1926	1552	1544	1372	824	232	248	233	282	416	440	675	1379
1927	1466	410	355	257	201	197	192	194	196	206	242	421
1928	886	454	337	258	201	192	195	234	298	270	302	516
1929	1025	966	754	887	579	710	1214	1444	1672	1095	2037	3180
1930	3608	3015	1684	402	331	217	238	310	366	348	558	980
1931	1302	1357	1313	1206	1282	1322	1401	1586	1742	2172	2989	3963
1932	3994	3260	1150	323	265	360	378	369	378	356	894	1887
1933	1972	1712	1439	1279	1215	805	1169	1372	1627	1946	2988	3870
1934	3941	3273	1633	830	861	1012	1391	1454	1637	2069	3011	3822
1935	3859	2169	1908	334	223	214	198	199	207	234	284	562
1936	969	1191	1309	293	231	209	207	207	209	235	286	434
1937	857	800	823	531	234	228	213	216	227	286	871	1993
1938	1782	453	200	204	217	197	192	192	196	209	292	480
1939	274	215	395	831	955	964	670	915	1426	834	855	1213
1940	1426	1020	894	288	241	196	191	198	208	233	271	421
1941	924	734	225	202	202	195	191	191	196	206	248	511
1942	551	490	199	203	191	198	194	191	191	201	246	662
1943	559	323	203	201	195	194	195	197	197	206	246	444
1944	979	715	663	379	225	207	263	322	428	502	1289	2310
1945	1970	1044	682	733	218	212	236	230	231	295	540	1256
1946	1486	1053	205	191	196	248	315	225	209	233	287	509
1947	977	974	774	641	404	253	287	344	436	450	815	1656
1948	1499	1349	1450	834	1046	348	208	198	201	227	279	534
1949	969	1225	1227	1261	988	216	221	291	414	441	545	902
1950	1224	1317	1342	491	207	200	226	226	227	280	483	705
1951	842	210	194	201	194	196	207	207	253	261	276	424
1952	878	862	213	212	193	197	191	189	191	202	301	311
1953	215	200	195	192	193	207	214	194	192	202	241	424
1954	661	462	521	248	192	192	191	197	206	228	279	463
1955	946	725	265	226	294	456	373	359	452	448	783	1280
1956	1448	1289	214	199	192	193	199	191	195	203	240	452
1957	268	322	751	679	232	192	206	212	219	273	348	478
1958	414	341	227	212	201	197	192	191	192	201	249	453
1959	279	253	625	227	202	231	304	355	441	445	637	774
1960	1113	715	671	529	231	202	256	317	370	358	860	1419
1961	1617	1245	739	856	283	317	387	358	437	440	1026	1579
1962	1699	1495	786	920	256	212	247	235	225	278	462	970
1963	245	243	215	297	197	204	190	191	195	205	240	394
1964	741	302	414	265	292	495	412	384	446	441	595	866
1965	1196	870	202	194	193	205	192	195	196	206	245	449
1966	1085	306	258	209	198	196	242	328	371	349	477	641
1967	1072	715	216	235	197	196	193	189	193	212	272	318
1968	213	196	239	213	191	194	221	303	363	349	419	596
1969	970	771	280	206	205	197	193	192	196	213	274	312
1970	226	196	193	196	192	194	204	270	307	268	312	497
1971	888	407	199	194	193	191	202	194	195	206	245	444
1972	373	492	310	211	205	207	257	333	371	354	396	628
1973	746	324	209	214	205	197	206	204	198	207	244	432
1974	778	210	192	192	191	189	189	192	195	206	240	409
1975	391	242	218	205	198	194	196	192	194	217	276	483
1976	262	204	244	585	750	744	788	1277	1668	1090	1923	2649
1977	3079	2828	1734	1420	1404	1812	1840	1743	2075	2398	3109	4035
1978	4321	3432	1411	246	212	209	200	203	201	214	276	477

" Monthly Average Electrical Conductivity at Jersey Point"
" 543b Basecase Simulation, CCWD at buildout, (JMM 10/90), 4J FDM µmhos/cm"

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	1004	1229	508	243	236	206	195	177	179	216	371	588
1923	942	736	241	217	204	274	363	213	196	346	643	784
1924	881	1142	1184	975	838	777	947	1061	1345	1674	2076	2955
1925	3136	2582	1875	1344	394	218	213	192	189	254	438	971
1926	1381	1323	1264	1195	367	245	248	222	324	704	864	1155
1927	1391	752	460	515	233	209	191	188	192	213	314	516
1928	788	628	420	303	220	180	184	196	246	366	470	634
1929	855	1054	1064	945	852	773	858	1027	1377	1671	1563	2435
1930	2653	2691	2164	709	365	323	214	240	300	538	649	919
1931	1119	1163	1334	1202	1173	1283	1359	1279	1451	1766	2115	2984
1932	3063	2703	1549	457	254	312	362	283	308	544	718	1377
1933	1637	1389	1351	1214	1182	1201	876	1008	1440	1898	2158	2946
1934	3096	2804	2102	1338	932	1038	1093	1174	1522	1908	2185	2946
1935	3014	2287	1783	722	255	218	197	183	187	252	421	597
1936	902	1157	1304	574	270	230	194	188	189	258	427	632
1937	833	1076	1060	630	263	263	231	195	196	345	653	1408
1938	1821	847	230	206	301	251	203	206	216	212	273	505
1939	290	200	375	744	938	1040	867	678	1129	1643	1182	1190
1940	1259	1333	1286	513	289	225	192	191	198	267	412	584
1941	774	1026	328	224	254	229	201	188	190	211	313	536
1942	703	682	246	221	200	197	195	185	186	202	298	570
1943	579	377	215	209	199	191	195	191	192	214	317	533
1944	776	1084	1051	563	244	212	210	241	335	677	1039	1776
1945	1946	1369	889	768	261	211	213	202	196	345	603	996
1946	1396	1331	262	173	177	234	292	209	188	258	427	610
1947	840	1068	1074	957	528	301	254	265	346	725	888	1318
1948	1574	1364	1324	1207	994	540	255	188	184	252	419	595
1949	905	1159	1324	1266	1153	319	196	228	332	702	938	977
1950	1100	1205	1261	660	256	207	229	207	197	348	583	823
1951	1105	287	192	205	197	194	201	199	220	353	451	587
1952	826	1051	306	238	205	201	187	184	195	204	288	341
1953	210	195	196	194	190	199	214	197	191	207	311	529
1954	876	743	643	562	196	179	181	182	187	252	421	609
1955	830	1051	394	222	280	502	495	309	362	740	886	1167
1956	1371	1448	307	235	205	192	201	190	194	209	304	496
1957	267	278	693	889	418	189	194	195	194	344	624	756
1958	655	488	283	224	251	231	198	186	194	205	292	539
1959	283	249	538	371	195	218	313	287	356	736	894	930
1960	942	1248	1135	831	376	217	211	242	305	552	727	1232
1961	1423	1337	1316	976	706	335	331	274	355	738	943	1407
1962	1448	1370	1298	1009	344	238	219	206	201	348	583	858
1963	409	260	262	290	219	208	190	186	190	215	329	535
1964	809	439	366	511	315	451	445	315	351	725	910	979
1965	1120	1164	257	192	191	196	194	188	190	211	312	536
1966	695	370	228	219	190	190	219	249	305	541	675	848
1967	928	1089	354	267	225	196	196	184	210	214	264	375
1968	203	178	212	256	182	180	198	231	296	541	686	809
1969	981	1117	443	229	261	215	198	196	196	211	273	383
1970	232	189	191	228	202	191	198	223	273	380	436	623
1971	893	554	212	193	188	188	197	195	192	217	331	543
1972	558	568	410	255	229	262	260	260	301	532	702	745
1973	921	460	221	245	241	205	200	196	194	217	324	527
1974	852	362	191	191	186	179	183	184	190	212	316	531
1975	512	268	207	210	191	183	186	179	178	219	388	594
1976	337	184	223	458	832	967	981	977	1378	1667	1513	2125
1977	2319	2502	2193	1478	1352	1124	1097	1096	1260	1562	2040	2958
1978	3035	2818	2137	400	255	273	251	207	199	208	285	538

" Monthly Average Chlorides at Old River at Rock Slough"
" 543b Basecase Simulation, CCWD at buildout, (JMM 10/90), 4J FDM mg/l"

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	75	102	63	29	49	33	17	21	36	20	25	40
1923	65	71	44	33	26	16	30	26	25	23	45	61
1924	65	84	95	81	67	60	77	94	112	142	179	259
1925	332	284	195	127	68	26	18	23	23	19	33	66
1926	112	117	111	103	53	20	18	20	27	44	67	85
1927	118	84	30	46	49	26	15	19	25	18	21	33
1928	57	59	33	24	17	17	14	20	26	26	34	45
1929	60	87	88	75	66	57	67	84	110	140	135	205
1930	263	270	232	90	32	30	19	23	28	36	52	69
1931	90	100	107	107	99	105	115	115	120	148	183	261
1932	317	290	189	53	33	29	27	28	30	36	57	101
1933	143	125	119	114	101	100	77	84	111	157	190	261
1934	316	287	225	124	88	84	91	100	122	159	191	263
1935	308	263	175	105	39	29	27	20	23	19	29	42
1936	67	94	112	73	61	32	15	21	25	19	29	44
1937	61	81	90	66	56	67	33	23	25	23	48	102
1938	161	93	24	21	69	38	43	37	26	28	24	33
1939	27	12	18	47	69	82	73	57	82	133	109	96
1940	105	110	105	74	57	53	18	19	25	20	28	39
1941	56	76	50	45	72	85	46	23	28	19	21	35
1942	49	50	36	41	37	18	22	18	24	18	21	37
1943	47	34	21	33	32	37	19	19	23	17	22	34
1944	52	79	85	53	36	22	20	24	28	43	77	137
1945	185	139	82	57	46	39	23	21	24	23	44	72
1946	118	116	48	12	16	15	20	23	23	19	29	43
1947	58	87	86	75	46	22	17	24	29	46	69	97
1948	143	126	116	102	83	57	23	23	20	18	29	42
1949	63	90	112	109	97	40	15	19	27	44	71	79
1950	88	104	111	73	25	15	15	19	22	22	43	61
1951	82	45	33	30	31	19	15	19	23	24	32	40
1952	59	86	44	47	38	37	24	35	48	23	23	27
1953	20	17	23	22	13	13	17	19	20	17	21	34
1954	58	63	45	54	18	13	14	19	23	19	29	42
1955	58	84	43	23	22	29	38	28	29	47	69	89
1956	113	124	58	58	39	15	17	28	39	20	21	33
1957	32	16	40	68	47	17	14	21	22	22	46	59
1958	53	35	25	29	71	77	100	37	44	21	21	34
1959	29	12	29	36	27	16	19	25	30	47	69	79
1960	75	99	99	76	43	20	20	25	29	37	57	92
1961	118	126	112	90	75	33	27	26	29	47	73	108
1962	127	131	115	88	71	33	18	22	24	23	42	62
1963	48	16	18	25	35	22	20	17	21	17	22	35
1964	55	47	20	43	22	28	33	29	30	46	70	77
1965	90	101	39	24	14	12	14	17	23	17	21	33
1966	50	48	23	21	19	12	15	25	30	36	52	63
1967	71	95	46	52	43	26	48	34	56	40	25	26
1968	24	15	15	24	21	17	15	23	28	36	54	62
1969	73	92	49	43	100	51	48	13	42	39	25	26
1970	23	17	23	58	36	19	14	21	27	26	32	42
1971	62	64	30	14	10	12	14	19	20	17	22	34
1972	39	37	40	18	16	18	21	27	30	35	54	61
1973	71	57	18	46	58	36	17	17	21	17	22	34
1974	59	48	25	26	17	14	11	13	20	17	21	33
1975	38	21	18	14	33	25	15	15	17	16	26	39
1976	30	12	10	19	54	72	80	83	108	141	133	182
1977	218	241	221	140	119	112	114	114	123	146	178	267
1978	319	304	233	87	68	110	136	41	39	28	23	34

" Monthly Average Chlorides at Rock Slough @ Contra Costa Canal "
" 543b Basecase Simulation, CCWD at buildout, (JMM 10/90), 4J FDM mg/l"

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	76	102	77	77	116	47	26	26	41	27	30	42
1923	66	77	82	80	33	21	39	32	31	29	48	64
1924	67	84	97	86	73	69	86	98	113	144	179	251
1925	330	288	205	144	132	38	28	29	29	24	38	66
1926	112	119	116	112	121	28	29	25	32	47	72	86
1927	120	94	34	72	147	41	26	24	30	24	26	36
1928	59	64	39	46	22	47	25	25	31	31	38	47
1929	61	89	93	84	71	63	76	88	111	143	139	199
1930	263	269	240	120	53	40	31	28	33	40	57	71
1931	92	102	109	117	105	111	123	120	121	150	183	253
1932	317	291	213	85	79	39	38	33	35	41	62	99
1933	145	128	125	133	106	106	87	88	111	157	191	253
1934	316	289	236	135	120	88	100	104	122	160	192	255
1935	310	269	182	163	47	66	48	25	29	25	33	45
1936	68	93	116	108	208	47	23	26	31	25	33	46
1937	63	81	96	93	146	168	49	29	31	28	52	99
1938	161	103	33	55	209	99	60	38	25	35	31	36
1939	31	14	21	48	72	89	83	63	83	134	116	99
1940	107	110	109	128	160	91	28	24	31	25	32	41
1941	58	76	71	135	162	114	80	31	33	25	26	37
1942	52	51	47	119	70	29	45	25	29	25	26	38
1943	50	38	27	100	47	77	34	24	28	23	27	36
1944	54	79	88	63	94	32	34	30	34	48	80	134
1945	186	145	90	69	100	72	36	26	30	28	49	72
1946	119	118	63	26	21	23	28	29	29	25	33	45
1947	60	88	91	80	55	31	28	29	35	49	74	96
1948	145	129	120	106	89	73	34	29	26	23	33	45
1949	65	89	117	116	103	70	24	25	32	47	74	82
1950	90	104	115	96	42	21	23	25	28	27	47	64
1951	83	55	63	80	47	30	25	25	29	29	36	42
1952	60	87	63	157	51	74	40	39	54	31	29	30
1953	23	21	31	61	17	21	28	25	26	23	26	36
1954	58	67	48	59	26	22	25	25	29	24	33	45
1955	59	85	55	70	28	34	48	34	34	50	74	90
1956	114	125	108	156	59	22	28	33	45	27	26	36
1957	37	18	39	70	59	26	22	28	28	27	48	61
1958	57	37	32	87	216	152	118	50	49	29	26	36
1959	33	14	30	44	65	24	28	31	35	50	74	83
1960	78	98	103	87	78	29	33	31	34	41	62	92
1961	120	128	116	113	81	47	40	32	34	50	77	108
1962	130	133	120	97	188	48	28	27	30	28	47	64
1963	57	18	22	69	66	48	38	22	26	23	26	37
1964	57	54	23	60	27	36	44	36	36	49	74	80
1965	92	103	60	74	20	19	25	23	28	23	26	35
1966	52	55	30	54	29	17	23	30	35	40	56	66
1967	73	98	59	180	55	53	70	46	48	49	32	29
1968	28	18	20	39	33	29	25	27	34	40	59	64
1969	75	94	61	157	182	76	66	19	30	48	32	29
1970	28	20	30	167	54	30	24	26	33	32	38	44
1971	63	71	64	34	12	19	23	25	26	22	27	37
1972	42	37	48	25	20	22	31	33	36	40	57	64
1973	74	65	26	171	152	56	28	22	26	23	27	37
1974	61	57	43	68	23	30	21	18	25	23	26	35
1975	42	24	24	20	68	69	25	20	23	22	31	41
1976	36	14	13	19	55	78	88	88	109	144	137	180
1977	218	239	228	148	124	129	129	122	125	149	177	256
1978	319	304	246	212	122	149	130	54	44	36	30	37

" Monthly Average Chlorides at Old River at Highway 4"
" 543b Basecase Simulation, CCWD at buildout, (JMM 10/90), 4J FDM mg/l"

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	46	63	57	43	64	43	23	27	44	26	24	33
1923	44	57	56	50	38	20	27	30	32	25	33	44
1924	44	52	60	53	46	43	54	62	69	78	93	131
1925	181	170	125	83	72	35	21	28	31	22	29	45
1926	67	75	72	69	57	26	20	23	29	32	44	53
1927	73	69	27	39	68	37	20	25	32	24	22	29
1928	41	50	33	28	24	25	20	25	31	25	28	33
1929	40	62	63	51	45	39	48	57	68	80	79	107
1930	137	156	138	73	35	31	23	27	31	29	37	46
1931	58	67	65	69	65	64	68	73	73	82	95	131
1932	167	174	137	53	45	33	26	30	33	30	41	61
1933	87	81	75	81	69	65	56	57	66	86	99	132
1934	167	169	140	81	69	59	59	66	72	88	99	134
1935	165	161	113	94	52	44	39	26	30	24	25	34
1936	44	58	70	65	85	39	20	26	33	24	25	34
1937	40	49	62	58	72	89	42	30	33	24	37	63
1938	92	70	28	35	40	22	42	20	13	31	30	33
1939	31	18	22	36	49	54	52	44	53	80	69	61
1940	67	67	64	74	84	69	25	26	32	24	25	31
1941	39	49	54	71	95	69	48	31	36	25	23	32
1942	38	39	43	60	48	26	33	26	32	25	23	34
1943	40	36	29	49	42	44	27	26	29	22	22	29
1944	35	50	55	43	50	30	24	31	31	32	48	77
1945	107	96	63	43	54	52	32	26	30	25	34	49
1946	72	76	49	22	26	20	22	26	29	22	25	33
1947	39	60	61	50	38	22	20	26	31	33	45	59
1948	85	80	73	63	50	46	25	27	26	20	24	32
1949	41	54	70	69	63	39	21	24	29	32	46	51
1950	57	66	71	60	29	17	17	23	27	23	32	42
1951	53	46	42	44	41	27	21	25	29	25	27	31
1952	38	60	47	69	47	43	33	38	52	30	26	31
1953	29	24	34	37	20	18	23	24	25	21	21	27
1954	38	46	35	40	22	18	20	25	29	22	24	32
1955	39	58	40	35	29	24	30	28	30	33	45	56
1956	69	76	62	86	53	21	24	36	48	27	21	30
1957	38	21	28	47	44	24	17	24	28	23	33	41
1958	39	29	28	46	101	96	60	44	50	28	22	30
1959	33	16	23	36	42	22	19	26	30	33	45	54
1960	54	61	62	53	43	25	23	30	31	30	41	57
1961	71	83	73	64	56	33	29	30	30	33	48	64
1962	79	85	76	56	86	43	20	26	30	23	31	42
1963	44	18	19	34	48	31	27	22	26	21	21	27
1964	36	44	23	36	22	22	30	29	31	33	46	49
1965	57	69	42	36	20	16	19	24	29	22	22	28
1966	38	50	34	33	30	17	20	29	33	29	37	43
1967	49	70	50	80	58	37	47	42	31	45	30	28
1968	32	21	24	31	33	26	22	27	32	29	39	42
1969	46	63	46	63	80	62	45	5	36	46	31	27
1970	31	27	34	82	50	28	20	25	31	25	28	32
1971	40	58	45	23	14	17	19	24	27	20	21	27
1972	29	28	38	24	22	18	22	30	34	30	38	45
1973	50	57	27	72	78	47	23	20	24	21	22	28
1974	40	49	38	40	26	21	15	15	22	20	21	27
1975	32	26	24	21	44	36	20	18	20	19	23	30
1976	30	20	16	16	33	46	53	57	67	80	80	102
1977	120	138	129	84	68	70	83	83	79	83	93	131
1978	153	184	152	102	93	103	65	50	46	40	28	31

" Monthly Average Chlorides at Clifton Court"
" 543b Basecase Simulation, CCWD at buildout, (JMM 10/90), 4J FDM mg/l"

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	43	57	53	46	62	42	25	38	47	26	24	32
1923	39	51	58	53	43	19	25	40	44	25	29	38
1924	44	46	47	47	37	43	55	63	67	74	90	112
1925	139	138	98	70	66	34	21	40	39	22	30	43
1926	60	68	66	55	53	25	18	33	36	29	39	48
1927	63	59	24	33	69	36	22	37	42	25	23	28
1928	40	46	31	27	25	26	21	36	37	24	24	29
1929	40	58	53	46	37	36	50	60	63	69	77	93
1930	114	118	109	59	32	28	27	36	36	26	34	42
1931	55	63	57	62	61	56	61	66	66	74	89	111
1932	133	136	109	47	47	32	27	39	39	27	39	54
1933	74	70	67	75	63	51	55	57	60	73	93	113
1934	139	133	113	62	62	55	57	63	64	76	93	114
1935	133	134	96	83	54	48	41	36	39	24	23	33
1936	42	52	62	58	83	38	20	37	41	24	23	29
1937	37	39	51	53	65	69	41	42	41	24	39	58
1938	75	56	28	40	30	18	35	16	11	37	34	35
1939	35	20	24	37	45	48	45	49	52	61	60	54
1940	57	53	49	69	81	64	26	38	41	24	24	28
1941	39	40	53	71	65	38	31	38	49	27	24	33
1942	34	35	45	61	47	29	38	31	43	27	24	37
1943	40	37	32	53	42	43	31	37	38	24	23	28
1944	34	39	43	37	55	30	30	42	38	30	45	67
1945	86	80	53	40	57	57	34	36	39	25	33	47
1946	63	62	50	25	36	20	23	36	36	22	23	30
1947	38	57	52	39	35	20	22	35	36	29	41	53
1948	72	70	60	45	42	38	24	37	31	20	22	30
1949	39	50	62	62	52	34	26	34	34	28	38	46
1950	52	60	60	51	27	16	16	32	33	22	30	37
1951	42	45	46	47	44	32	23	35	36	25	24	27
1952	36	53	45	70	42	40	36	38	43	31	30	33
1953	35	27	38	40	22	22	24	31	31	22	21	25
1954	29	38	30	32	21	18	21	35	35	22	22	27
1955	39	49	36	37	29	21	26	35	36	29	41	50
1956	60	64	57	62	40	23	28	45	48	28	22	31
1957	42	22	28	39	42	25	17	32	34	22	27	33
1958	32	26	28	49	90	69	28	45	45	28	23	29
1959	38	17	27	36	46	21	18	33	36	29	39	50
1960	51	45	45	41	39	23	26	38	36	27	39	50
1961	62	77	56	56	46	31	31	40	35	29	43	57
1962	67	77	58	46	84	42	23	37	35	22	29	39
1963	40	19	19	34	52	32	30	31	32	22	21	25
1964	34	43	25	32	19	24	29	36	36	29	39	44
1965	50	57	40	44	21	17	20	36	38	24	23	26
1966	43	51	38	36	33	17	23	41	38	26	32	36
1967	46	59	48	80	55	45	39	41	21	41	33	29
1968	36	23	28	32	38	32	24	38	37	26	33	36
1969	40	51	42	66	44	52	33	4	23	51	33	28
1970	37	32	39	65	49	35	22	37	37	25	26	29
1971	36	56	46	24	15	18	20	34	32	21	21	25
1972	24	26	35	26	24	17	22	41	40	27	31	41
1973	45	55	28	74	75	48	27	24	29	22	21	27
1974	36	48	43	45	31	24	16	20	26	21	21	24
1975	29	27	26	27	48	38	21	21	23	19	22	27
1976	30	23	17	18	28	39	47	59	63	70	75	89
1977	107	111	105	70	60	91	92	89	95	90	96	121
1978	135	142	112	95	87	58	31	50	61	47	29	32

" Monthly Average Chlorides at Tracy Pumping Plant"
" 543b Basecase Simulation, CCWD at buildout, (JMM 10/90), 4J FDM mg/l"

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	68	81	68	64	63	44	41	58	49	47	47	55
1923	61	71	69	63	57	46	50	64	65	49	53	63
1924	69	73	68	74	63	71	75	82	83	90	107	125
1925	147	147	114	96	90	65	51	68	62	47	51	65
1926	81	88	86	79	81	54	49	63	61	53	63	71
1927	83	82	51	61	78	62	52	62	62	49	46	52
1928	67	67	54	53	49	54	50	63	59	48	51	59
1929	66	81	73	73	60	66	70	80	82	93	97	109
1930	122	127	127	85	63	56	53	64	59	50	57	66
1931	78	85	82	90	84	82	85	88	85	90	106	127
1932	139	135	118	71	70	59	55	65	61	50	59	74
1933	90	89	89	94	83	73	72	79	78	89	110	127
1934	147	139	130	84	84	80	76	84	82	91	109	129
1935	143	138	110	96	75	63	52	61	61	49	47	58
1936	67	78	84	76	84	58	43	63	64	49	48	52
1937	64	68	73	69	64	58	56	62	62	49	58	73
1938	90	76	54	56	30	17	33	16	11	48	54	48
1939	50	47	48	59	62	72	66	72	73	81	80	78
1940	78	79	77	87	113	64	44	59	61	48	47	52
1941	63	67	69	76	52	27	24	57	63	48	46	53
1942	55	58	57	66	49	53	55	58	59	48	47	52
1943	53	58	51	64	44	44	45	60	59	48	47	53
1944	62	67	66	60	68	54	53	70	61	53	65	85
1945	103	92	69	63	67	67	55	63	62	49	57	66
1946	82	79	59	45	54	46	47	62	59	47	49	57
1947	65	79	70	61	55	48	50	63	60	54	63	74
1948	94	92	81	76	72	64	49	67	55	45	48	57
1949	67	77	88	88	79	64	51	63	57	53	65	71
1950	74	81	82	74	54	45	43	61	56	48	54	64
1951	68	67	51	54	49	55	48	62	59	48	49	55
1952	63	76	66	77	41	38	42	38	39	48	53	47
1953	44	50	56	57	48	54	52	60	58	46	47	54
1954	56	62	57	58	48	49	49	63	58	47	48	56
1955	65	74	62	65	56	55	57	67	60	53	63	74
1956	80	87	84	52	35	45	49	59	49	47	46	55
1957	49	51	57	59	58	48	43	64	59	47	52	59
1958	58	53	52	69	87	56	20	50	42	47	49	51
1959	47	44	57	57	59	50	50	62	60	53	64	78
1960	74	69	71	67	66	50	51	65	60	50	58	72
1961	84	101	81	89	69	63	56	67	58	53	62	79
1962	85	97	80	76	93	61	51	63	58	46	53	63
1963	65	48	47	66	74	64	60	61	54	45	46	53
1964	66	69	56	60	51	56	57	64	61	53	64	71
1965	74	82	64	56	43	49	50	61	59	48	46	52
1966	63	66	54	55	51	43	47	63	59	50	57	65
1967	68	81	63	93	56	63	35	41	21	39	53	48
1968	41	47	48	54	56	63	51	63	59	50	61	65
1969	66	75	62	87	33	50	31	4	22	59	54	48
1970	49	49	51	59	50	57	48	61	58	48	51	58
1971	64	76	66	49	41	46	48	62	56	45	47	54
1972	52	55	59	51	51	43	49	64	62	51	56	64
1973	70	74	52	91	77	53	53	48	52	47	47	54
1974	64	70	57	53	45	50	47	51	48	48	47	50
1975	54	51	49	56	55	59	46	50	49	47	49	52
1976	55	49	43	52	61	71	70	78	81	93	97	107
1977	121	123	125	97	94	112	103	105	115	106	114	142
1978	141	149	131	109	84	52	25	58	72	62	51	55

" Monthly Average Electrical Conductivity at San Andreas Landing"
" 543b Basecase Simulation, CCWD at buildout, (JMM 10/90), 4J FDM µmhos/cm"

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	285	340	233	215	225	191	174	161	170	176	190	219
1923	268	256	208	211	191	180	203	180	177	186	225	256
1924	262	305	320	295	265	264	293	317	362	425	531	770
1925	902	728	523	407	257	198	183	177	175	178	202	284
1926	365	367	358	335	233	191	181	180	188	226	265	320
1927	387	272	204	247	215	182	165	167	171	172	181	206
1928	250	237	205	195	181	169	172	177	181	189	205	228
1929	262	304	309	291	265	256	274	302	361	398	420	630
1930	754	754	598	283	216	203	181	181	186	208	236	277
1931	318	334	358	347	337	354	368	357	376	434	539	778
1932	868	780	486	241	221	205	194	186	188	209	250	365
1933	429	384	377	369	345	328	288	301	366	462	549	772
1934	849	763	571	372	324	314	319	335	385	460	556	777
1935	851	659	512	346	218	201	181	171	175	178	197	224
1936	275	329	368	275	266	206	175	174	176	179	197	227
1937	258	298	318	261	247	254	205	176	176	186	234	372
1938	462	284	179	189	282	223	176	182	196	179	181	202
1939	181	171	187	242	280	302	271	245	306	386	336	328
1940	358	363	355	285	273	206	168	168	173	177	193	217
1941	249	291	214	218	249	208	177	165	168	172	181	208
1942	228	234	182	205	179	172	167	158	164	171	180	213
1943	215	195	173	189	175	164	166	165	168	172	182	207
1944	243	293	304	229	212	192	182	183	190	225	297	443
1945	511	390	290	263	202	203	184	175	174	185	221	291
1946	367	357	183	165	171	177	181	175	174	178	197	224
1947	255	304	307	284	221	187	181	184	191	229	270	347
1948	423	385	374	335	306	231	191	174	173	177	197	224
1949	270	321	366	358	323	201	176	179	189	226	273	290
1950	318	345	362	260	190	180	177	175	174	185	220	259
1951	300	175	169	184	174	167	170	170	175	184	201	219
1952	256	306	198	221	178	178	158	161	177	173	181	184
1953	166	170	175	179	168	171	174	171	172	172	181	207
1954	254	250	233	251	176	170	170	173	175	178	197	224
1955	260	296	207	206	198	207	212	190	192	231	270	319
1956	372	388	218	216	183	169	175	166	173	173	180	205
1957	180	176	230	269	221	173	174	175	175	186	227	254
1958	235	206	184	206	255	205	165	158	178	173	180	206
1959	179	172	208	206	187	182	186	187	192	231	270	283
1960	291	329	332	281	225	189	182	183	187	210	250	334
1961	375	374	352	321	298	213	194	186	191	231	283	363
1962	396	391	358	313	269	214	181	177	177	186	219	268
1963	212	175	175	214	186	184	163	163	168	172	183	209
1964	254	211	190	237	196	203	203	191	192	229	271	287
1965	325	334	176	171	165	170	166	164	167	171	181	206
1966	236	206	184	191	181	174	177	183	187	208	236	263
1967	287	322	210	271	202	173	168	157	192	182	181	186
1968	171	170	175	192	172	171	175	180	186	208	240	259
1969	295	318	215	214	239	185	172	172	176	181	181	186
1970	171	168	172	215	179	165	169	177	181	188	199	223
1971	263	237	183	172	167	165	169	171	170	172	183	208
1972	210	215	206	186	180	189	187	185	188	207	242	255
1973	281	224	176	239	218	180	169	168	170	172	182	208
1974	258	212	169	172	161	155	156	162	169	172	182	206
1975	206	179	178	176	181	169	171	168	168	174	192	217
1976	187	170	172	193	252	284	293	297	358	398	411	545
1977	622	665	572	409	376	352	351	346	367	421	537	799
1978	923	855	613	298	240	262	219	176	178	177	181	207

" Monthly Average Chlorides at Middle R. at Woodward Island"
" 543b Basecase Simulation, CCWD at buildout, (JMM 10/90), 4J FDM mg/l"

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	30	42	45	46	61	41	24	28	42	24	22	29
1923	31	43	54	52	40	20	24	27	31	24	24	31
1924	32	33	34	33	28	31	39	44	47	51	61	79
1925	100	94	68	50	59	34	21	28	31	21	25	35
1926	42	48	47	41	48	26	17	21	27	23	29	35
1927	47	49	22	31	68	35	20	26	31	24	21	26
1928	32	40	30	27	27	25	20	25	29	22	21	25
1929	29	46	43	34	28	27	34	41	45	46	50	65
1930	84	81	71	45	32	28	23	27	28	23	27	32
1931	39	46	39	43	44	38	40	45	46	50	61	78
1932	97	99	84	43	47	31	22	27	30	23	31	42
1933	52	49	46	58	47	37	39	40	42	49	63	79
1934	96	89	74	42	50	43	39	44	45	51	63	79
1935	95	94	71	73	52	48	40	26	29	23	21	28
1936	32	38	45	51	79	36	21	26	32	23	21	26
1937	28	28	41	47	67	80	38	30	31	23	31	47
1938	53	43	27	39	64	31	41	29	22	31	30	33
1939	30	21	24	30	36	35	33	33	38	40	40	38
1940	43	38	34	64	88	66	25	27	31	23	21	26
1941	30	31	50	74	90	68	40	27	35	25	23	30
1942	29	31	43	59	45	26	35	24	33	25	23	33
1943	34	35	32	49	40	37	25	26	28	22	21	25
1944	25	28	32	30	52	31	23	31	29	24	34	49
1945	59	61	43	33	50	51	30	25	29	23	28	38
1946	47	47	42	25	30	21	21	25	27	21	20	26
1947	28	45	41	29	29	19	18	24	28	23	30	39
1948	51	51	43	30	27	31	23	27	26	19	19	25
1949	28	35	44	43	37	28	21	24	26	23	27	33
1950	38	45	44	42	27	17	16	22	26	20	25	30
1951	32	39	40	43	41	27	21	25	28	22	20	23
1952	27	44	41	67	42	38	30	34	45	27	27	32
1953	30	26	39	40	22	20	23	24	25	21	19	22
1954	23	31	26	27	22	19	21	26	28	21	19	23
1955	28	39	31	38	30	19	21	24	27	23	30	36
1956	44	47	49	76	45	22	26	37	45	25	20	28
1957	37	21	23	32	37	26	17	23	27	21	22	26
1958	25	24	27	51	100	81	61	36	46	26	21	27
1959	32	17	22	33	44	22	16	23	27	23	29	37
1960	39	32	31	31	37	24	21	28	29	23	30	38
1961	43	56	39	41	38	27	25	28	27	23	31	41
1962	49	57	43	32	81	43	19	25	28	20	24	30
1963	34	19	18	37	49	31	27	22	25	20	18	22
1964	25	37	24	29	19	18	24	25	27	23	28	31
1965	37	45	34	36	21	17	19	24	28	22	22	24
1966	32	46	37	37	35	19	22	28	31	23	26	28
1967	35	49	45	83	58	38	43	34	46	42	29	28
1968	33	24	28	33	36	27	23	26	30	23	27	28
1969	29	41	37	61	97	54	40	9	34	40	30	27
1970	33	31	39	74	45	29	20	25	29	22	22	25
1971	27	50	46	26	16	19	19	25	26	19	19	21
1972	19	23	32	25	24	17	20	28	31	24	25	34
1973	36	51	29	75	73	43	22	18	22	20	19	24
1974	29	45	41	40	29	22	14	14	20	20	19	21
1975	25	27	27	22	45	34	20	18	18	18	20	24
1976	26	24	18	15	21	28	34	40	45	46	50	63
1977	73	75	65	43	38	49	65	62	59	61	65	84
1978	104	106	79	89	92	106	92	42	42	39	27	29

FUTURE CONDITIONS
LOS VAQUEROS RESERVOIR WITH AN OLD RIVER AT HIGHWAY 4 INTAKE
PROJECT ALTERNATIVE COMPARED TO
NO-ACTION FUTURE CONDITIONS

Difference in Electrical Conductivity at Antioch
Changes which meet screening criteria
Rock Slough/Old River Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924							23					
1925												
1926												
1927												
1928												
1929							20					
1930				146	74							
1931												
1932												
1933												
1934												
1935												
1936												
1937												
1938												
1939												
1940												
1941												
1942			24									
1943												
1944												
1945												
1946						38						
1947						50						
1948												
1949												
1950												
1951												
1952												
1953												
1954												
1955							2					
1956												
1957												
1958												
1959												
1960												
1961												
1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972									-75	-111		
1973												
1974												
1975												
1976												
1977												
1978												

Decreases = 2 No Change = 677 Increases = 5
Differences with base near D1485: Increases = 3 Decreases or No Change = 6

Difference in Electrical Conductivity at Emmaton
Changes which meet screening criteria
Rock Slough/Old River Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924											31	
1925												
1926												
1927												
1928												
1929												
1930				21	42							
1931												
1932												
1933												
1934												
1935												
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944									1			
1945												
1946												
1947												
1948												
1949												
1950												
1951												
1952												
1953												
1954												
1955												
1956												
1957												
1958												
1959												
1960												
1961												
1962												
1963												
1964									1			
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977											3	
1978												

Decreases = 0 No Change = 682 Increases = 2
Differences with base near D1485: Increases = 4 Decreases or No Change = 7

Difference in Electrical Conductivity at Jersey Point
Changes which meet screening criteria
Rock Slough/Old River Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928											1	
1929												
1930				490	122							
1931											1	
1932											7	
1933											52	
1934												
1935												
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944												
1945												
1946												
1947												
1948												
1949												
1950												
1951												
1952												
1953												
1954												
1955							1					
1956												
1957												
1958												
1959												
1960											4	
1961												
1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969												
1970											3	
1971												
1972										-47		
1973												
1974												
1975												
1976								-49	-69			
1977												
1978												

Decreases = 3 No Change = 679 Increases = 2
Differences with base near D1485: Increases = 7 Decreases or No Change = 4

Difference in Chlorides at Old River at Rock Slough
Changes which meet screening criteria
Rock Slough/Old River Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930				59	31							
1931												
1932												
1933												
1934												
1935												
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944												
1945												
1946												
1947												
1948												
1949												
1950												
1951												
1952												
1953												
1954												
1955												
1956												
1957												
1958							9					
1959												
1960												
1961												
1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969					7							
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977												
1978												

Decreases = 0 No Change = 680 Increases = 4
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Rock Slough @ Contra Costa Canal
Changes which meet screening criteria
Rock Slough/Old River Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922		-11	12	42	103	70						
1923	-7		25	123	153	36						
1924		-8		12	6			6				5
1925	9	37	57	77	135	203						
1926				13	62	144						
1927	-8	22	10	8	76	95						
1928				24	77	41	8					
1929		-13		18	13							-24
1930	-20		28	117	192	35						
1931					18			8				
1932	7	18	80	133	48	71	7					
1933		16		14	53	18	18					
1934	2	21	40	83	95	93	7					
1935	7	33	50	60	194	17						
1936	-6	-9	-8	41	36	118						
1937		-9	-6	28	71	167	103					
1938		37			153	288	38					
1939	10			-7	-19	-14	12				11	
1940				37	141	259	38					
1941		-8	12	57	132	189	85					
1942			7	37	166	136	6					
1943	7		10	38	166	82	15					
1944		-11			18	43						-13
1945	-10	25	26	20	69	143	65					
1946	-7	7	16									
1947		-13		14								
1948	-14	13		15	20	21						
1949	-6	-10	-12	10	23	17						
1950				31								
1951		6	13	82	157	16						
1952		-12		55	152	9	8					
1953				36	18							
1954												
1955		-13		10	53	6		6				
1956			52	88	136							
1957	8	10	-8	-8	10							
1958	8		6	32	33	188	176	27				
1959	11				12	68						
1960	6	-10		11	44	16						
1961			8	26	69			6				
1962			8	22	-22	99						
1963	18			31	66							
1964	-6		10		64	8						
1965			11	35	139	34						
1966				29	99	8						
1967		-13	12	114	190		11					
1968				8	36							
1969		-8	7	52	140	164						
1970				10	108							
1971		10										
1972	6			24	21							
1973		9		148	221	168	13					
1974	-7		17	56	23							
1975				9		71	16					
1976	12				-11							
1977			19	65	39	10	12	11				-26
1978		20	47	51	203	182	118	16				

Decreases = 37 No Change = 440 Increases = 207
Differences with base near D1485: Increases = 12 Decreases or No Change = 8

Difference in Chlorides at Old River at Highway 4
Changes which meet screening criteria
Rock Slough/Old River Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924										8	10	12
1925	12											
1926												
1927												
1928												
1929												7
1930				33	25							
1931											6	8
1932	11											
1933											9	8
1934											7	7
1935	11											
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944												
1945												
1946												
1947												
1948												
1949												
1950												
1951												
1952												
1953												
1954												
1955												
1956												
1957												
1958												
1959												
1960												
1961												
1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969					-6							
1970												
1971												
1972												
1973												
1974												
1975												
1976												7
1977	7									7	9	10
1978	16					-13						

Decreases = 2 No Change = 661 Increases = 21
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Clifton Court
Changes which meet screening criteria
Rock Slough/Old River Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924											6	7
1925	8											
1926												
1927												
1928												
1929												
1930				24	21							
1931												
1932												
1933												
1934												
1935												
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944												
1945												
1946												
1947												
1948												
1949												
1950												
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1952												
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1958												
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1961												
1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977												
1978												

Decreases = 0 No Change = 679 Increases = 5
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Tracy Pumping Plant
Changes which meet screening criteria
Rock Slough/Old River Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930				18	15							
1931												
1932												
1933												
1934												
1935												
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944												
1945												
1946												
1947												
1948												
1949												
1950												
1951												
1952												
1953												
1954												
1955												
1956												
1957												
1958												
1959												
1960												
1961												
1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977												
1978												

Decreases = 0 No Change = 682 Increases = 2
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Electrical Conductivity at San Andreas Landing
Changes which meet screening criteria
Rock Slough/Old River Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930				174	58							
1931												
1932												
1933												
1934												
1935												
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944												
1945												
1946												
1947												
1948												
1949												
1950												
1951												
1952												
1953												
1954												
1955												
1956												
1957												
1958												
1959												
1960												
1961												
1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977												
1978												

Decreases = 0 No Change = 682 Increases = 2
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Middle R. at Woodward Island
Changes which meet screening criteria
Rock Slough/Old River Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930				20	16							
1931												
1932												
1933												
1934												
1935												
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944												
1945												
1946												
1947												
1948												
1949												
1950												
1951												
1952												
1953												
1954												
1955												
1956												
1957												
1958												
1959												
1960												
1961												
1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969					12							
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977												
1978						9	7					

Decreases = 0 No Change = 679 Increases = 5
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

FUTURE CONDITIONS
LOS VAQUEROS RESERVOIR WITH A CLIFTON COURT FOREBAY INTAKE
PROJECT ALTERNATIVE COMPARED TO
NO-ACTION FUTURE CONDITIONS

Difference in Electrical Conductivity at Antioch
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924							31					
1925												
1926												
1927												
1928												
1929							11					
1930				133	70							
1931												
1932												
1933												
1934												
1935												
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944												
1945												
1946						40						
1947						66						
1948												
1949												
1950												
1951										-62		
1952												
1953												
1954												
1955							2					
1956												
1957												
1958												
1959												
1960					40							
1961												
1962												
1963												
1964												
1965												
1966									76	114		
1967												
1968										101		
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977	-395											
1978												

Decreases = 2 No Change = 674 Increases = 8
Differences with base near D1485: Increases = 3 Decreases or No Change = 6

Difference in Electrical Conductivity at Emmaton
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924											6	
1925												
1926												
1927												
1928												
1929												
1930					41							
1931											4	
1932												
1933												
1934												
1935												
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944									2			
1945												
1946												
1947												
1948												
1949												
1950												
1951												
1952												
1953												
1954												
1955												
1956												
1957												
1958												
1959									1			
1960												
1961												
1962												
1963												
1964									1			
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977											3	
1978												

Decreases = 0 No Change = 683 Increases = 1
Differences with base near D1485: Increases = 6 Decreases or No Change = 5

Difference in Electrical Conductivity at Jersey Point
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924						41						
1925												
1926												
1927												
1928												
1929												
1930				481	119							
1931											4	
1932											7	
1933											63	
1934												
1935												
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944												
1945												
1946												
1947						21						
1948												
1949												
1950												
1951												
1952												
1953												
1954												
1955							1					
1956												
1957												
1958												
1959												
1960					26						7	
1961												
1962												
1963												
1964												
1965												
1966										40		
1967												
1968										34		
1969												
1970											3	
1971												
1972												
1973												
1974												
1975												
1976									71			
1977	-180											
1978												

Decreases = 1 No Change = 675 Increases = 8
Differences with base near D1485: Increases = 6 Decreases or No Change = 5

Difference in Chlorides at Old River at Rock Slough
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930				58	31							
1931												
1932												
1933												
1934												
1935												
1936												
1937												
1938												
1939												
1940												
1941												
1942												
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1946												
1947												
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1951												
1952												
1953												
1954												
1955												
1956												
1957												
1958							6					
1959												
1960												
1961												
1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976									9			
1977	-14	-13										
1978												

Decreases = 2 No Change = 678 Increases = 4
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Rock Slough @ Contra Costa Canal
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922		-11	11	50	102	52						
1923	-6	9	33	127	163	40						
1924		-8		12				6				1
1925	5	35	56	77	135	203						
1926				13	62	144						
1927		19	10		63	90						
1928		7	15	27	79	42	8					
1929		-13		18								-22
1930	-14		23	114	190	32						
1931					18			11				
1932	7	19	81	110	53	101	10					
1933		17		15	53	18	18					1
1934	4	22	41	83	95	93	7					
1935	8	33	51	60	194	29						
1936	-6	-9	-8	42		99						
1937		-10	-6	23	34	144	91					
1938		27			139	279	39					
1939	10			-10	-9	-11	13				7	
1940				38	141	260	32					
1941		-7	28	29	136	76	31					
1942			13	42	171	140	6					
1943	7		10	39	157	74	14					
1944		-11			37	41		6				-9
1945		27	17	21	76	147	64					
1946	-8	7	18									
1947		-13		15								
1948	-10	15	7	16	20	21						
1949		-8	-12	11	23	41	35					
1950				22	22	44						
1951		7	12	90	160	15						
1952		-12		57	86		6					
1953				36	18							
1954												
1955		-13		12	63	8		6				
1956			53	63	69							
1957	8		-7	-20	11							
1958	8		6	33	28	184	119	18				
1959	11				18	76						
1960	6	-10			37	14						
1961			9	26	26							
1962			10	24	21	110						
1963	18			31	110							
1964	-6	11	13		65	8						
1965			10	31	135	33						
1966		6		29	99	8						
1967		-13	11		146		15					
1968				8	36							
1969		-7		47	149	189	9					
1970				10	178	17						
1971		13										
1972	6			24	21							
1973		14		138	215	170	11					
1974	-7	6		42	22							
1975	6					71	16					
1976	12				-24	-7		6		8		-12
1977	-14	-23		58	36	9	12	11				-26
1978		20	47	51	203	182	45	14				

Decreases = 37 No Change = 436 Increases = 211
Differences with base near D1485: Increases = 13 Decreases or No Change = 7

Difference in Chlorides at Old River at Highway 4
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924										10	10	12
1925	10											
1926												
1927												
1928												
1929											6	9
1930	8			33	25							
1931											8	11
1932	14											
1933											11	11
1934	9	9								6	9	10
1935	15											
1936												
1937												
1938												
1939												
1940												
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1942												
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1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976									7	6		6
1977										8	11	12
1978	19						7					

Decreases = 0 No Change = 656 Increases = 28
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Clifton Court
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												7
1925	7											
1926												
1927												
1928												
1929												
1930				23	20							
1931												6
1932	8											
1933												
1934	7											
1935	8											
1936												
1937												
1938												
1939												
1940												
1941												
1942												
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1971												
1972												
1973												
1974												
1975												
1976												
1977												
1978	7											

Decreases = 0 No Change = 675 Increases = 9
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Tracy Pumping Plant
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930				17	15							
1931												
1932												
1933												
1934												
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1936												
1937												
1938												
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1972												
1973												
1974												
1975												
1976												
1977												
1978												

Decreases = 0 No Change = 682 Increases = 2
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Electrical Conductivity at San Andreas Landing
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930				172	57							
1931												
1932												
1933												
1934												
1935												
1936												
1937												
1938												
1939												
1940												
1941												
1942												
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1963												
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1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977	-50	-37										
1978												

Decreases = 2 No Change = 680 Increases = 2
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Middle R. at Woodward Island
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930				19	16							
1931												
1932												
1933												
1934												
1935												
1936												
1937												
1938												
1939												
1940												
1941												
1942												
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1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977												
1978							6					

Decreases = 0 No Change = 681 Increases = 3
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

FUTURE CONDITIONS
DESALINATION
PROJECT ALTERNATIVE COMPARED TO
NO-ACTION FUTURE CONDITIONS

NOTE: OLD RIVER AT ROCK SLOUGH
OLD RIVER NEAR HIGHWAY 4
CLIFTON COURT FOREBAY
TRACY PUMP PLANT
SAN JOAQUIN RIVER AT SAN ANDREAS LANDING
MIDDLE RIVER AT WOODWARD ISLAND
HAD NO CHANGES MEETING THE SCREENING CRITERIA

Difference in Electrical Conductivity at Antioch
Changes which meet screening criteria
Desalination Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929							14					
1930												
1931							20					
1932							13					
1933												
1934							21					
1935												
1936												
1937												
1938												
1939							1					
1940												
1941												
1942												
1943												
1944												
1945												
1946												
1947												
1948												
1949												
1950												
1951												
1952												
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1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977												
1978												

Decreases = 0 No Change = 684 Increases = 0
Differences with base near D1485: Increases = 5 Decreases or No Change = 4

Difference in Electrical Conductivity at Emmaton
Changes which meet screening criteria
Desalination Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930												
1931												
1932												
1933												
1934												
1935												
1936												
1937												
1938												
1939												
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1941												
1942												
1943												
1944												
1945												
1946												
1947												
1948												
1949												
1950												
1951												
1952												
1953												
1954												
1955												
1956												
1957												
1958												
1959									1			
1960												
1961									1			
1962												
1963												
1964									1			
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977												
1978												

Decreases = 0 No Change = 684 Increases = 0
Differences with base near D1485: Increases = 3 Decreases or No Change = 8

Difference in Electrical Conductivity at Jersey Point
Changes which meet screening criteria
Desalination Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930												
1931												
1932											3	
1933											2	
1934												
1935												
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944												
1945												
1946												
1947												
1948												
1949												
1950												
1951											1	
1952												
1953												
1954												
1955												
1956												
1957												
1958												
1959												
1960												
1961												
1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969												
1970											1	
1971												
1972												
1973												
1974												
1975												
1976												
1977												
1978												

Decreases = 0 No Change = 684 Increases = 0
Differences with base near D1485: Increases = 4 Decreases or No Change = 7

Difference in Chlorides at Rock Slough @ Contra Costa Canal
Changes which meet screening criteria
Desalination Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												1
1925	3											
1926												
1927												
1928												
1929												
1930												
1931												
1932	1											
1933												
1934												
1935	2	1										
1936												
1937												
1938												
1939												
1940					-9							
1941												
1942												
1943												
1944												
1945												
1946												
1947												
1948												
1949												
1950												
1951												
1952				-8								
1953												
1954												
1955												
1956												
1957												
1958												
1959												
1960												
1961												
1962												
1963												
1964												
1965												
1966												
1967				-10								
1968												
1969				-8								
1970												
1971												
1972												
1973				-9								
1974												
1975												
1976												
1977		1										1
1978												

Decreases = 5 No Change = 679 Increases = 0
Differences with base near D1485: Increases = 7 Decreases or No Change = 13

FUTURE CONDITIONS
MIDDLE RIVER AT WOODWARD ISLAND INTAKE
PROJECT ALTERNATIVE COMPARED TO
NO-ACTION FUTURE CONDITIONS

NOTE: SAN JOAQUIN RIVER AT SAN ANDREAS LANDING
HAD NO CHANGES MEETING THE SCREENING CRITERIA

Difference in Electrical Conductivity at Antioch
Changes which meet screening criteria
Middle River Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930												
1931							1					
1932							1					
1933												
1934							2					
1935												
1936												
1937												
1938												
1939							1					
1940												
1941												
1942												
1943												
1944												
1945												
1946												
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1968												
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1971												
1972												
1973												
1974												
1975												
1976												
1977												
1978												

Decreases = 0 No Change = 684 Increases = 0
Differences with base near D1485: Increases = 4 Decreases or No Change = 5

Difference in Electrical Conductivity at Emmaton
Changes which meet screening criteria
Middle River Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924											3	
1925												
1926												
1927												
1928												
1929												
1930												
1931											4	
1932												
1933											4	
1934											2	
1935												
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944									1			
1945												
1946												
1947												
1948												
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1950												
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1952												
1953												
1954												
1955												
1956												
1957												
1958												
1959									1			
1960												
1961												
1962												
1963												
1964									1			
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977											5	
1978												

Decreases = 0 No Change = 684 Increases = 0
Differences with base near D1485: Increases = 8 Decreases or No Change = 3

Difference in Electrical Conductivity at Jersey Point
Changes which meet screening criteria
Middle River Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925											1	
1926												
1927												
1928											1	
1929												
1930												
1931											6	
1932											1	
1933											5	
1934											4	
1935												
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
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1965												
1966												
1967												
1968												
1969												
1970											1	
1971												
1972												
1973												
1974												
1975												
1976												
1977												
1978												

Decreases = 0 No Change = 684 Increases = 0
Differences with base near D1485: Increases = 7 Decreases or No Change = 4

Difference in Chlorides at Old River at Rock Slough
Changes which meet screening criteria
Middle River Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930												
1931												
1932												
1933												
1934												
1935	16											
1936												
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1957												
1958							7					
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1963												
1964												
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977						6				8	11	
1978												

Decreases = 0 No Change = 679 Increases = 5
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Rock Slough @ Contra Costa Canal
Changes which meet screening criteria
Middle River Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922		-10	27	41	109	150	25					
1923	-6		25	118	158	35	-9	6				
1924		-7		13	15	8		6				3
1925	8	38	59	78	134	203	44					
1926			6	14	62	142	17					
1927		29	29		39	178	41					
1928		6	15	25	79	40	41					
1929		-12		19	34	16						
1930	9	9	32	117	170	129	37					
1931					19			8				3
1932	13	25	84	189	206	159	14					
1933		18		16	54	19	19					3
1934	9	26	41	87	95	92	8	7				5
1935	14	38	52	62	195	92	123	13				
1936		-8	-7	43	54	231	37					
1937		-7		29	61	168	154					
1938		48	38	33		200	118	10				
1939	11	7		-12	-22	-14	13	6			6	
1940				38	141	260	131					
1941		-7	18	25	130	190	129	17				
1942			8	27	157	133	44	10				
1943	7		10	38	166	82	72					
1944		-11		26	28	103	7	6				
1945		30	35	41	69	148	66					
1946	-7	8	50	66	55	17						
1947		-12		16	36	33	8					
1948		16	9	17	21	22	27	6				
1949		-8	-11	12	24	56	43					
1950				41	106	74	10					
1951		29	8	72	149	80	13					
1952		-11	32		182	89	78					
1953				36	111	18						
1954			9	-6	26	12						
1955		-11	26	31	133	27		6				
1956			49	85	202	80						
1957	8	10	-10	-21		24	7					
1958	9	11		25	25	185	178	27				
1959	11	9		6	13	64						
1960	7	-9		19	50	90	7					
1961			10	26	68	45	10					
1962	7		12	26	-20	175	23					
1963	18	15		12	108	124	101	11				
1964		13	14		60	7						
1965			51	72	155	38						
1966		7	15	31	111	48						
1967		-12	38	-27	180	84	44	14				
1968				8	36	26	11					
1969		-7	29	-38	80	171	17	10				
1970				10	189	94	15					
1971			38	124	101	17						
1972	6			25	21							
1973		13	41	-51	120	232	67					
1974	-6	14	25	56	122	40	26					
1975	6	11		8		76	77					
1976	12	7			-26	-7	6	6				
1977			23	67	41	12	14	13		8		-22
1978		25	50	52	203	182	120	19				

Decreases = 33 No Change = 369 Increases = 282
Differences with base near D1485: Increases = 17 Decreases or No Change = 3

Difference in Chlorides at Old River at Highway 4
Changes which meet screening criteria
Middle River Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924										8	10	13
1925	14	9										
1926												
1927												
1928												
1929											7	9
1930	15	11	7									
1931										7	10	13
1932	19	11										
1933	6									6	11	13
1934	17	11								7	11	14
1935	19											
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944												
1945	6											
1946												
1947												
1948												
1949												
1950												
1951												
1952												
1953												
1954												
1955												
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1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976											6	7
1977	12	9	7			6			6	10	13	14
1978	22	12										

Decreases = 0 No Change = 646 Increases = 38
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Clifton Court
Changes which meet screening criteria
Middle River Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924											6	8
1925	9											
1926												
1927												
1928												
1929												
1930	8	7										
1931											6	9
1932	11	7										
1933											7	8
1934	10	7									6	8
1935	11											
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944												
1945												
1946												
1947												
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1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977	6	6								6	8	8
1978	9	8										

Decreases = 0 No Change = 661 Increases = 23
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Tracy Pumping Plant
Changes which meet screening criteria
Middle River Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												7
1925												
1926												
1927												
1928												
1929												
1930												
1931												7
1932	7											
1933												7
1934											6	
1935	8											
1936												
1937												
1938												
1939												
1940												
1941												
1942												
1943												
1944												
1945												
1946												
1947												
1948												
1949												
1950												
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1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977											6	
1978												

Decreases = 0 No Change = 677 Increases = 7
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Middle R. at Woodward Island
Changes which meet screening criteria
Middle River Future Project vs. No-Action

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923												
1924												
1925												
1926												
1927												
1928												
1929												
1930												
1931												
1932												
1933												
1934												
1935												
1936												
1937												
1938					-6							
1939												
1940												
1941												
1942												
1943												
1944												
1945												
1946												
1947												
1948												
1949												
1950												
1951												
1952												
1953												
1954												
1955												
1956												
1957												
1958												
1959												
1960												
1961												
1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969					-9							
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977												
1978												

Decreases = 2 No Change = 682 Increases = 0
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

NO ACTION FUTURE CONDITION
COMPARED TO
NO ACTION EXISTING CONDITION

Difference in Electrical Conductivity at Antioch
Changes which meet screening criteria
No-Action vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922		270	94				62			49		-420
1923	-384	843	109			-55						-608
1924	-843				275			-263				
1925		458		823	194			22	23	-114	-290	
1926			431	776	167		-47	-54		-384	-1166	-1481
1927	-951		603	462							-96	-976
1928	-754	512	731	395	74			28			-145	-871
1929	-324	621			574	605	1341	1614	964		378	1917
1930	2493	2995	2380	513	209	72	46			-610	-1420	-1569
1931	-953	-497	737	1488	1714	1616	1160	604	278			
1932			968	336	59	63	12			-526	-737	-1249
1933	-2385	-2304		1113	1483	962	195					
1934			906	1129	784	297	165			382		
1935			1705	558	25				31		-1075	-2345
1936	-1751	-540	608	356				42	43	56		-1034
1937	-852			-724	-82			91	115	74	257	629
1938	921	603	74									386
1939	437	261	690	948	617	333	217			-482	-1438	-1988
1940	-1316	-541		52						56	-99	-1061
1941	-873										-114	-825
1942	476	1986	215									-406
1943	845	1113	141								-130	-944
1944	-1343	-625	-407	-1223	-278	-69	-184	-82			279	690
1945	453	700	986	759	71		-46	132	101	124	348	464
1946	310	848	129			181	161	45	22	52	-118	-812
1947	-445	373		-428			-107	-75		-204	-593	-510
1948			834	857	1069	348	-80		40	65	-120	-540
1949		1279	1476	1665	1388	180		119	107	-571	-1579	-1931
1950	-1211	-452	734	909	124			169	116	66	414	333
1951		86						72	155	122	-84	-800
1952	-514	258	66									164
1953	176	79					22				-82	-595
1954		1590	1637	413	21				22		-173	-841
1955	-287	204	75	32			92	62			-516	-530
1956		1115	99								-107	-591
1957	-64	909	1760	583	44			75	83			-508
1958	191	587	274									
1959	186	573	1011	169							-347	-662
1960	-526	-1325	-1048	-525	-214	-91	-55					
1961				224	189	288	352	111		-312	-504	
1962				535	159		47					
1963	177	516	346	602	68						-100	-887
1964	-376	414	486	217			188	111		-600	-1481	-1962
1965	-1408	-446										-817
1966	-1463		370	100			64				-160	-1026
1967	-660									33	-55	75
1968	95	33	201	110							-335	-1074
1969	-430		-179								-117	199
1970	224	34									-246	-953
1971	-761	652	37							45		-670
1972	-381	1652	975	-93	-159	75	106				-285	-591
1973	-451	265	177					50	24		-339	-1035
1974	-750	199								40	-103	-151
1975	963	550	188	-642	-78					88	-109	-158
1976	239	122	118	341	743	215	605	1072	735	-475		1858
1977	2409	2895	1555	356	275							
1978				37		30	28				-192	-449

Decreases = 143 No Change = 309 Increases = 232
Differences with base near D1485: Increases = 8 Decreases or No Change = 2

Difference in Electrical Conductivity at Emmaton
Changes which meet screening criteria
No-Action vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922		152										-229
1923	-51	147									-48	-254
1924	-61	126	-79	128			243	235		179	-182	-479
1925		157		419							-111	
1926			316	159						-134	-548	-611
1927	-298		81	46								-391
1928		81	92	36							-27	-409
1929	216	191	-71	116	78	168	708	607	306	-166	515	1175
1930	1673	1422	823	73			21			-150	-443	-579
1931	-349	-81	442	521	628	531	462	276		120	-166	-369
1932		494	226	50						-225	-441	-930
1933	-1356	-751	303	406	537	184	140			-366		-433
1934		491	381	220	184	108	67		-108	-314	140	-326
1935		260	899	59							-348	-901
1936	-513	-273	365	40								-475
1937	-51			-230							110	351
1938	472	82										56
1939	49		103	273	162	101		69		-215	-758	-923
1940	-488	-138	106									-413
1941												-375
1942		277										-229
1943	47	118									-21	-386
1944	-251	-143	-136	-286	-24						190	376
1945	160	171	194	189						21	108	117
1946	181	216					30				-30	-377
1947	123	123	-50	-143						-70	-268	-171
1948			576	178	445	41					-24	-228
1949	239	531	502	605	372			29		-196	-684	-775
1950	-421	-226	467	140							118	
1951												-293
1952	61	75										
1953												-240
1954		227	271	40							-30	-385
1955	183					23	21		4	-39	-299	-200
1956	265	442										-220
1957	-29	125	411	67								-200
1958	45	76	23									-58
1959	24	53	242						4		-175	-205
1960	-135	-603	-196	-137	-24		27					
1961			-49	132	24	58	118	30	2	-120	-191	
1962			-61	258	23		23					49
1963		48	22	69								-357
1964		41	106	22		60	70	25	8	-213	-572	-768
1965	-461	-103										-372
1966	-134		43								-73	-461
1967	113	-73									-30	
1968			22								-153	-426
1969	75		-27								-36	27
1970	24										-72	-338
1971	-77	99										-271
1972	-77	269	102								-55	-209
1973	-107	36									-77	-332
1974	-152											-37
1975	128	47		-89							-34	-39
1976	22			140	215		176	337	201	-273	419	1076
1977	1472	1248	192		-99	107	107				295	
1978	-290										-39	-116

Decreases = 129 No Change = 392 Increases = 163
Differences with base near D1485: Increases = 6 Decreases or No Change = 8

Difference in Electrical Conductivity at Jersey Point
Changes which meet screening criteria
No-Action vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922			34									
1923	-127	209	27								61	
1924	-340	-222			133	90	-84	-178	-111	-150		
1925		202		143	61						-27	
1926				245	76						-156	-416
1927	-349		143	245								-93
1928	-320	102	166	91	29						28	-71
1929	-347				217	178	101	343	316	135	99	717
1930	1001	1224	810	-50		44				-44	-274	-424
1931	-343	-240	-74	281	391	439	318	173	108		111	
1932	-166		392							80	-60	-377
1933	-979	-1004	-479	182	337	362	84			207	124	
1934	-267		231	417	302	115	55		99	276	72	
1935	-238		321	246						24	-26	-462
1936	-559	-168		147								-55
1937	-354	-104		-117	-23					22	57	209
1938	200	192	28									98
1939	75	24	126	235	201	116	120			101	-214	-595
1940	-462	-204		30								-90
1941	-385	-146										-105
1942	192	455	54									-63
1943	157	172	23									-89
1944	-423	-256	-84	-245	-75		-25				72	261
1945	202	276	340	227	23							115
1946		284	41			29	28				31	-69
1947	-334		72			21	-30	-23			-75	-150
1948				194	165	-175	-69				23	-51
1949	-161	109	268	368	377	63			25		-126	-480
1950	-420	-175		192	51							100
1951		24								26	24	-43
1952	-257											33
1953												-28
1954		422	408	277							28	-54
1955	-292		32			-33				44		-160
1956	-111	118	28									-62
1957		96	380	276	62							39
1958	94	169	67									
1959	30	71	217	85							43	-86
1960	-133	-75	-270	-102	-61	-28	-41			29		66
1961					142	55				69	-74	
1962					41							
1963	67	69	70	65								-52
1964	-229	74	77	131	30	-102	-114				-157	-460
1965	-437	-178										-78
1966	-485	-54	30	24							43	-75
1967	-369	-87										35
1968				43							69	-82
1969	-261											37
1970	28											-90
1971	-289	98										-51
1972	-52	306	213	47	-28	22	31			29		-70
1973	-94	53										-110
1974	-196	86										
1975	217	90	21	-57							33	
1976	54			49	140	123	177	320	321	89		645
1977	902	1203	936	295	183							
1978						35	30					-72

Decreases = 114 No Change = 389 Increases = 181
Differences with base near D1485: Increases = 2 Decreases or No Change = 7

Difference in Chlorides at Old River at Rock Slough
Changes which meet screening criteria
No-Action vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922					-6							
1923	-12	9										
1924	-23	-26			9	8		-8	-9	-11		
1925		23	11	13	11							
1926				19	10						-9	-37
1927	-42	-10	7	24								-7
1928	-27		10	7		-7						
1929	-28				13	18	13	29	31	17	9	62
1930	108	136	110		-11						-18	-38
1931	-39	-26	-11	23	37	43	36	22	11			
1932	-25		33		-8						-10	-33
1933	-102	-119	-61	10	32	36	15			12	11	
1934	-36		30	35	32	14	7		6	14		
1935	-34		30	34	9						-6	-33
1936	-60	-28		14								
1937	-28	-15	-7	-9	-9	-9						15
1938	25	18			7			7	7			
1939				17	19	12	8			8	-12	-55
1940	-56	-27	-8			-7						-8
1941	-28	-17	-7		-8	-26	-15	-6				-7
1942		29	10		-6			-10				
1943		8			-6							-6
1944	-33	-29	-10	-17	-13							21
1945	25	22	28	21	7	6						7
1946	9	20	8									
1947	-26	-7										-16
1948				16	17	-17	-17					
1949	-14	7	23	36	38	10					-8	-38
1950	-48	-24	-6	15								
1951			-18	-6								
1952	-18	-6			-7				-12			
1953												
1954		29	31	34								
1955	-23											-16
1956	-10	9		-19	-30			-8				-6
1957	-8		26	29	8							
1958	6	13	6		-6	6	11		-8			
1959			14	9								-8
1960	-14	-9	-22	-11	-8							
1961					17	8						-9
1962												
1963			6		7							
1964	-20			13			-9				-10	-36
1965	-48	-24										-6
1966	-34	-14										
1967	-30	-13					-6	-16				
1968												
1969	-23			-6	16		-10		10	-6		
1970				-8								-6
1971	-23											
1972	-8	16	21	6								
1973	-12				-7			-6	-9			-8
1974	-19							-8	-8			
1975	8	7				-7		-7	-12			
1976					12	11	14	24	26	15		53
1977	94	125	114	41	19	11	9	7				
1978					16	47	80	12				

Decreases = 130 No Change = 428 Increases = 126
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Rock Slough @ Contra Costa Canal
Changes which meet screening criteria
No-Action vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922				-8	-12	-8	-8					
1923	-11	7		-9								
1924	-20	-26			6	8		-8	-9	-11		3
1925		20	11	9								
1926				16	6						-8	-34
1927	-42	-14		19					-6			-6
1928	-25		9			-8						
1929	-27				10	18	16	27	31	18	7	56
1930	105	132	113	8	-18		6				-17	-36
1931	-39	-25	-12	21	37	43	37	22	11			5
1932	-24		25		-16						-9	-26
1933	-94	-120	-66		30	35	15			10	13	
1934	-34		29	30	27	14	6			12		
1935	-31		26	22	9						-7	-28
1936	-59	-31		9	-17	-6						
1937	-27	-15	-7	-10	-17	-17	-8					13
1938	25	17						6				
1939				17	19	12	6				-9	-51
1940	-58	-30	-8	-8	-22	-11	-6					-8
1941	-26	-18	-11	-15	-13	-8	-18	-9				-6
1942	-6	26	12	-11	-10			-9	-6			
1943	-8	7		-10	-10			-6				-6
1944	-29	-30	-12	-16	-19		8					20
1945	25	19	25	20		7	7					6
1946	10	16	8									
1947	-25	-8										-16
1948	-8			14	18	-12	-21					
1949	-13		23	34	39	11					-9	-34
1950	-48	-27	-7	10								
1951			-21	-15								
1952	-17	-7		-17	-12	-9			-8	-7		
1953				-10								
1954	-6	26	30	35								
1955	-22			-6								-16
1956	-11	7		-15	-45	-8		-8				-6
1957	-10		23	29	8							
1958		12	6	-7	-18		6					
1959			13	10								-8
1960	-13	-8	-21	-12	-12	-6	6					
1961					14	11	10					-9
1962												
1963												
1964	-18			10			-6				-9	-33
1965	-48	-26	-9	-10								-6
1966	-31	-18										
1967	-28	-13	-8	-19	-8		-6	-23				
1968												
1969	-22			-17			-7				-6	
1970				-14	-10							-6
1971	-22											
1972	-9	12	21									
1973	-12			-17	-13			-6	-10			-7
1974	-18			-7				-8	-9			
1975	6	7				-12	-9	-8	-12			
1976					12	10	12	22	25	16		49
1977	90	120	116	45	19	14	10	8				1
1978	1		2		14	22	42	15				

Decreases = 166 No Change = 403 Increases = 115
Differences with base near D1485: Increases = 6 Decreases or No Change = 12

Difference in Chlorides at Old River at Highway 4
Changes which meet screening criteria
No-Action vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922					-7							
1923	-7											
1924	-10	-15								-13	-6	
1925	-12	10	6		6							
1926				10							-6	-21
1927	-23	-8		12					-6			
1928	-15					-10						
1929	-15					9	11	18	17	7		20
1930	41	73	60		-13			6			-10	-21
1931	-22	-12	-10	10	19	23	20	15	6			
1932	-20		17		-10						-7	-13
1933	-44	-62	-40		17	21	11			6		
1934	-26		14	17	17	7				7		
1935	-24		13	19	10						-8	-17
1936	-32	-19		6	-9							
1937	-17	-10		-6	-9	-11						6
1938	10	10										
1939				8	10	7				6	-8	-30
1940	-32	-17	-7		-8	-8						
1941	-16	-11	-6		-9		-6	-7				
1942	-9	12	6		-7			-11	-7			
1943	-9				-6			-6				
1944	-19	-17	-7	-9	-10		8	8				7
1945	13	9	13	10		6	7					
1946		8										
1947	-14											-10
1948	-6			8	7	-9	-14					
1949	-9		10	17	21	7						-20
1950	-26	-15	-6	7								
1951			-13	-8								
1952	-12			-8	-9				-7	-7		
1953				-7	-6							
1954		13	16	19								
1955	-13											-9
1956	-6			-12	-19			-6				
1957	-7		12	15								
1958					-7							
1959												-6
1960	-8		-13	-8	-8			7				
1961					9	7	9	8				-8
1962												
1963					6							
1964	-13			6							-6	-20
1965	-28	-16		-6	-6							
1966	-15	-8										
1967	-15	-7			-6			-10				
1968												
1969	-14			-8	26				15		-6	
1970				-13	-8							
1971	-13				-7							
1972	-7	6	14									
1973	-8				-10			-8	-15			-7
1974	-13						-7	-13	-15			
1975						-9	-9	-12	-18			
1976					6			9	9			21
1977	41	63	58	21	6			6			-10	
1978	8				16	20		12		6		

Decreases = 133 No Change = 459 Increases = 92
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Clifton Court
Changes which meet screening criteria
No-Action vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922				-6			-7					
1923												
1924							8	7			-9	
1925	-9	7		8								
1926				6				9			-8	-18
1927	-16	-6		6					-7			-7
1928						-15						-9
1929						9	21	20	13	6	7	18
1930	36	50	50		-13		10	11			-9	-16
1931	-15	-9		14	21	19	20	14			-9	
1932	-9		8		-11			8	6	-11	-23	-25
1933	-33	-46	-21	7	18	15	9					
1934	-14		15	11	11	7	6			-6		
1935	-11		17	12	12			6		-6	-13	-16
1936	-24	-16										-9
1937	-7			-7	-6							
1938	12		-6									
1939				7	6	6					-8	-24
1940	-23	-13			-8							-8
1941			-6									-6
1942	-14	6						-14				
1943									-6			-6
1944	-15	-13	-7	-9	-9		14	11	6			
1945	8		6	8		7	9					
1946												
1947								8				-8
1948				6	9	-7	-10					
1949		9	14	20	18		6	7			-9	-16
1950	-18	-11										
1951												-6
1952										-7		
1953				-8	-8				-7			-6
1954		7	11	12								-8
1955												-9
1956		7										
1957			11	7					-8			
1958					-6							
1959			7					7				-8
1960	-6	-9	-9	-7	-9		9	11				
1961					6	7	14	14				-8
1962							8	10				
1963					7							-7
1964								7			-8	-18
1965	-22	-12			-8				-6			-6
1966		-7			-6			6				-8
1967	-6		-6	-6								
1968								7				-9
1969	-8			-9	13				6		-6	
1970												-6
1971	-6				-10	-7						
1972	-6		10	6					-8			-6
1973	-6							-16	-20		-7	-10
1974	-10	-6				-7	-10	-19	-21			
1975	-10			9		-12	-12	-20	-24			
1976	-6			6	7							16
1977	37	44	43	14		13	16	11				
1978	13				11	-12	-8	7		8		

Decreases = 124 No Change = 459 Increases = 101
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Tracy Pumping Plant
Changes which meet screening criteria
No-Action vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922							-9					
1923												
1924									-6			
1925		8		8								
1926								10				-11
1927	-11											
1928												
1929						7	13	13	8	13	12	20
1930	30	39	45		-9		6	12			-6	-12
1931	-12	-8		15	19	16	14	9				
1932			7		-8					-10	-25	-26
1933	-27	-37	-15	7	15	9						
1934			16	8	9							
1935			16	8	11						-10	-10
1936	-19	-10										-8
1937												
1938	9				6							
1939				6								-14
1940	-16	-10							6			-6
1941											-6	
1942							6					
1943	8											
1944		-7	-6	-8	-7				7			
1945	7			7		8	8					
1946	8	6			6							
1947								7				-6
1948				9	9	-6	-12					
1949		9	15	19	17							-11
1950	-14	-9										
1951			12			7						
1952									6			
1953												
1954			9	7								
1955												-6
1956		8						9				
1957			10						-7			
1958												
1959								8				
1960		-9	-7	-7	-7	-6		8				
1961				7		8	8	13	-7			
1962				7				6				
1963					7	7						
1964			6					9				-10
1965	-15	-8			-6							
1966												
1967								6				
1968												
1969	-7					7				8		
1970												
1971					-7					6		
1972	-6											
1973				-10				-9	-12			
1974									-14			
1975				8		-6		-9	-11			
1976							11	7		13	10	18
1977	33	36	42	16		13	19	18	10		8	20
1978	21					-12		7				

Decreases = 59 No Change = 532 Increases = 93
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Electrical Conductivity at San Andreas Landing
Changes which meet screening criteria
No-Action vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923		27										
1924	-47	-42						-23		-25		-50
1925		55		43								
1926				40							-24	-86
1927	-90			55								
1928	-47											
1929	-47				29	32	29	58	62	25	43	196
1930	303	351	226	-42							-43	-84
1931	-75	-48		52	76	88	71	38				
1932	-65		80									-114
1933	-270	-254	-94	32	70	63	23			35		-45
1934	-89		70	74	57	26				36		
1935	-77		95	67								-79
1936	-119	-47		34								
1937	-49	-27		-24								39
1938	51	35										
1939				36	36	23					-40	-128
1940	-117	-49										
1941	-55	-35										
1942		60										
1943												
1944	-65	-49		-39								54
1945	47	53	58	42								
1946		49										
1947	-44											-35
1948				32	38	-70	-35					
1949		21	54	76	68						-23	-87
1950	-95	-45		30								
1951												
1952	-33											
1953												
1954		61	58	65								
1955	-37											-30
1956		25										
1957			52	48								
1958		24										
1959			26									
1960	-23	-29	-39	-21								
1961					38							
1962												
1963												
1964	-31			27							-23	-83
1965	-101	-45										
1966	-72											
1967	-55	-27										
1968												
1969	-36											
1970												
1971	-43											
1972		36	27									
1973	-21											
1974	-35	21										
1975	23											
1976					23		31	52	57	21	31	155
1977	239	301	218	69	37							
1978						36	21					

Decreases = 65 No Change = 536 Increases = 83
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Middle R. at Woodward Island
Changes which meet screening criteria
No-Action vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922					-7							
1923												
1924								6			-7	-9
1925	-7											
1926											-6	-14
1927	-11							-6	-7			
1928						-11						
1929							12	14	10			12
1930	29	34	29		-12		6	8			-6	-12
1931	-10			7	12	11	12	10				-9
1932	-8				-9					-6	-10	-16
1933	-24	-27	-12		10	9	7					-9
1934	-11		9	6								-7
1935	-9		12	9	8						-10	-12
1936	-15	-10			-8							
1937					-7	-9						
1938	7		-7					6	6			
1939											-7	-18
1940	-15	-8			-7	-6						
1941					-8	-11	-7	-7				
1942	-12				-6			-13	-6			
1943	-10							-6				
1944	-12	-8		-6	-6		8	10				
1945												
1946												
1947												
1948						-6	-8					
1949			8	11	10						-8	-12
1950	-11	-6										
1951			-8									
1952				-6	-7							
1953				-6	-7				-6			
1954				6								-6
1955												-6
1956				-15	-16							
1957	-6											
1958					-6		6					
1959												-7
1960	-6	-6	-6	-6	-6			8				
1961							9	9				-7
1962								7				
1963												
1964	-6						6				-6	-13
1965	-16	-9			-6							
1966												-7
1967								-6				
1968												-8
1969	-7			-7	21							
1970				-13	-6							
1971					-10	-6						
1972	-6		6						-6			
1973					-8			-12	-15			-7
1974	-9					-6	-9	-16	-17			
1975	-8					-8	-9	-14	-20			
1976	-6											11
1977	25	28	22									
1978					13	27	37	9		6		

Decreases = 112 No Change = 523 Increases = 49
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

FUTURE CONDITIONS
LOS VAQUEROS RESERVOIR WITH AN OLD RIVER AT HIGHWAY 4 INTAKE
PROJECT ALTERNATIVE COMPARED TO
NO-ACTION EXISTING CONDITIONS

Difference in Electrical Conductivity at Antioch
Changes which meet screening criteria
Rock Slough/Old River Future Project vs Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922		269					66			49		-420
1923	-384	843	109			-54						-606
1924	-842				328	212		-306				
1925		489		829	194			25	24	-114	-290	
1926			431	776	167			-48		-401	-1172	-1485
1927	-967		602	477	22						-96	-977
1928	-754	526	786	405	75			28			-144	-871
1929	-325	612			636	666	1361	1633	972		329	1767
1930	2220	2955	2366	659	283	89	50			-610	-1419	-1582
1931	-966	-501	735	1487	1714	1619	1155	579	284			
1932			971	341	69	67	7			-499	-703	-1230
1933	-2377	-2317		1094	1487	963	200					
1934	-527		912	1130	773	288	163			360		
1935			1714	560	26				31		-1075	-2346
1936	-1751	-523	626	347				46	41		-93	-1104
1937	-928			-727	-81			95	117	66	279	639
1938	906	588	74									386
1939	437	269	694	950	617	333	217			-490	-1482	-1974
1940	-1297	-535	222	63						56	-99	-1061
1941	-873										-114	-825
1942	476	2087	239									-406
1943	845	1139	143								-130	-944
1944	-1343	-629	-407	-1209	-273	-68	-184	-82			294	668
1945	366	563	886	731	70		-45	132	101	125	348	476
1946	326	853	128			219	210	50	22	52	-113	-806
1947	-442	383		-431			-98	-72		-203	-601	-507
1948			825	866	1078	350	-76		37	41	-168	-613
1949		1265	1470	1628	1403	179		119	106	-573	-1581	-1929
1950	-1211	-457	704	896	131			170	116	66	414	333
1951		85						74	155	123	-84	-799
1952	-514	255	62									168
1953	177	83					23				-84	-592
1954		1628	1657	418	21				22		-198	-905
1955	-331	195	54	35			94	64			-481	-503
1956		1103	92								-107	-591
1957	-64	909	1760	583	52			76	83			-507
1958	198	628	281									
1959	186	594	1023	171							-347	-661
1960	-526	-1325	-1048	-518	-194	-90	-55					
1961				245	192	304	371	87		-317	-499	
1962			-220	504	147		54					
1963	177	542	374	617	70						-131	-945
1964	-415	419	490	217			188	111		-600	-1481	-1961
1965	-1408	-442										-817
1966	-1463		374	100			65				-160	-1026
1967	-660									33	-56	75
1968	95	34	200	110							-335	-1074
1969	-430		-184								-116	199
1970	224	36									-233	-948
1971	-758	661	37							45		-672
1972	-381	1652	1002	-89	-158	75	107			-178	-328	-614
1973	-463	263	192					52	28	34	-320	-1027
1974	-746	196								28	-104	-151
1975	963	571	202	-640	-78					89	-109	-159
1976	238	124	120	343	744	215	605	905	589	-498		1836
1977	2457	2932	1568	365	281							
1978						31	29				-196	-452

Decreases = 146 No Change = 305 Increases = 233
Differences with base near D1485: Increases = 8 Decreases or No Change = 2

Difference in Electrical Conductivity at Emmaton
Changes which meet screening criteria
Rock Slough/Old River Future Project vs Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922		155										-229
1923	-50	148									-48	-253
1924	-60	127	-79	128			256	246	142	261		-407
1925		171		421							-110	
1926			317	159						-135	-549	-665
1927	-257		80	48								-391
1928		83	100	37							-27	-409
1929	217	190	-73	117	87	182	716	616	321	-172	524	1122
1930	1624	1453	826	94	53		22			-150	-442	-582
1931	-353	-82	442	521	628	534	466	277		117	-166	-367
1932		498	228	51						-220	-432	-922
1933	-1352	-754	293	400	539	186	143			-376	-207	-408
1934		486	389	221	181	105	69		-108	-320	119	-343
1935		267	904	59							-348	-901
1936	-513	-268	371	38								-484
1937	-64			-231							121	354
1938	465	81										56
1939	49		104	274	163	101		69		-213	-764	-889
1940	-478	-138	114									-413
1941												-375
1942		289										-229
1943	47	121										-386
1944	-251	-143	-136	-284	-24				1		199	381
1945	165	140	172	190						22	108	124
1946	188	218				22	38				-30	-375
1947	124	127	-52	-144						-70	-270	-166
1948			580	180	448	41					-28	-241
1949	229	526	505	598	372			29		-196	-684	-774
1950	-417	-222	465	138							118	
1951												-294
1952	62	75										
1953												-240
1954		233	275	41							-31	-393
1955	193					24	22		4	-38	-292	-189
1956	275	448										-219
1957	-29	125	411	67								-200
1958	45	81	23									-58
1959	24	56	246						4		-175	-205
1960	-134	-603	-196	-135	-22		27					
1961			-43	138	25	63	122	28	2	-121	-187	
1962			-74	249	21		25					49
1963		50	24	71								-365
1964		41	106	22		60	70	25	9	-213	-572	-768
1965	-460	-101										-372
1966	-134		44								-72	-460
1967	113	-68									-30	
1968			22								-153	-426
1969	76		-27								-36	27
1970	24										-71	-336
1971	-76	101										-271
1972	-77	269	105							-33	-62	-212
1973	-109	35									-75	-331
1974	-152											-37
1975	128	48		-89							-34	-39
1976	22			141	215		176	295	174	-264	392	1049
1977	1501	1261	192		-99	104	103				298	
1978	-282										-40	-117

Decreases = 129 No Change = 389 Increases = 166
Differences with base near D1485: Increases = 7 Decreases or No Change = 7

Difference in Electrical Conductivity at Jersey Point
Changes which meet screening criteria
Rock Slough/Old River Future Project vs Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922			33									
1923	-126	209	27								60	
1924	-339	-221			155	125	-72	-193	-130	-160		
1925		221	97	147	62						-27	
1926				246	77						-158	-427
1927	-369		142	257								-93
1928	-320	106	183	95	31						29	-71
1929	-347				235	203	110	350	318	86		658
1930	887	1215	809	440	125	63				-44	-274	-425
1931	-346	-241	-74	282	392	439	313	161	110		112	
1932			395							78	-53	-370
1933	-974	-1007	-488	176	344	360	85			196	176	
1934	-316		239	417	298	114	55		100	270	54	
1935	-231		328	248	21					24	-26	-462
1936	-558	-162		144								-72
1937	-368	-114		-118	-22					21	64	201
1938	181	186	28									98
1939	75	26	127	236	201	116	120				-253	-600
1940	-462	-216		33								-90
1941	-385	-145										-105
1942	192	486	62									-63
1943	157	179	24									-89
1944	-422	-256	-84	-238	-73		-25				78	258
1945	156	210	296	225	24							118
1946		287	41			35	39				32	-67
1947	-333		62		41	37	-27	-22			-77	-150
1948				192	169	-174	-66					-67
1949	-174	104	265	357	374	62			25		-127	-476
1950	-414	-177	-67	186	55							100
1951		24								26	24	-43
1952	-256											35
1953												-28
1954		439	415	280							25	-69
1955	-306		27			-31						-149
1956	-114	102	27									-62
1957		96	380	277	69							40
1958	95	182	69									
1959	30	75	221	86							43	-85
1960	-133	-75	-270	-98	-47	-27	-40				36	79
1961					144	60				68	-72	
1962		-71			38							
1963	67	75	77	69								-66
1964	-241	73	78	132	31	-102	-114				-157	-460
1965	-436	-181										-77
1966	-485	-50	31	25							44	-75
1967	-368	-84										35
1968				43							69	-81
1969	-261		-24									38
1970	28											-87
1971	-287	102										-51
1972	-52	306	222	49	-28	23	31					-77
1973	-98	52									22	-107
1974	-195	84										
1975	218	92	24	-56							33	
1976	54			49	140	123	178	271	252			637
1977	905	1207	944	306	189							
1978						36	31					-73

Decreases = 115 No Change = 388 Increases = 181
Differences with base near D1485: Increases = 2 Decreases or No Change = 7

Difference in Chlorides at Old River at Rock Slough
Changes which meet screening criteria
Rock Slough/Old River Future Project vs Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922					-6							
1923	-11	10										
1924	-22	-25			10	12		-6	-7			
1925		30	14	15	12							
1926				20	10						-8	-36
1927	-42	-11	7	25								-6
1928	-26		11	7		-7						
1929	-27				14	21	16	31	34	17	10	62
1930	101	138	113	61	20	7					-18	-37
1931	-38	-24	-10	24	38	45	37	23	13	8	9	
1932	-18		36		-7						-9	-31
1933	-98	-117	-60	10	33	37	16			13	15	
1934	-32		35	37	33	15	9		8	16		
1935	-25		34	35	9						-6	-32
1936	-60	-27		15								
1937	-28	-15	-6	-9	-9	-9						17
1938	26	18			6			8	7			
1939				18	20	13	9			8	-14	-54
1940	-55	-26	-7			-6						-8
1941	-28	-16	-7		-8	-23	-14	-7				-7
1942		30	11		-6			-10				
1943		8			-6							-6
1944	-32	-28	-10	-17	-13		6				6	24
1945	25	18	24	21	7	6						8
1946	11	22	8									
1947	-25	-6										-15
1948				16	17	-17	-17					
1949	-14	7	24	36	38	10					-8	-37
1950	-46	-23	-6	15								
1951			-18	-6								
1952	-18	-6			-7				-12			
1953												
1954		31	32	35								
1955	-24											-14
1956	-8	10		-18	-29			-9				
1957	-8		26	29	8							
1958	7	14	6			8	20		-8			
1959			14	9								-7
1960	-13	-8	-21	-10	-7							
1961					18	9	6					-7
1962												
1963			6		7							
1964	-20			13			-9				-9	-35
1965	-46	-23										
1966	-33	-14										
1967	-29	-11						-16				
1968												
1969	-22			-6	23		-10		10	-6		
1970				-7								-6
1971	-22											
1972	-7	16	21	6								-6
1973	-11				-7			-6	-9			-7
1974	-18							-8	-8			
1975	9	7				-7		-7	-12			
1976					12	12	15	23	23	13		58
1977	99	128	117	43	21	14	11	9	7			
1978					16	49	85	14				

Decreases = 125 No Change = 424 Increases = 135
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Rock Slough @ Contra Costa Canal
Changes which meet screening criteria
Rock Slough/Old River Future Project vs Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	-6	-11	13	34	91	62	-8					
1923	-18	10	23	114	153	36						
1924	-17	-34	-8	11	12	12			-7			8
1925		57	68	86	134	206						
1926			7	29	68	144					-7	-34
1927	-50	8	15	27	73	97			-6			-6
1928	-30		11	29	78	33	7					
1929	-28	-18		15	23	21	19	31	31	20	11	32
1930	85	129	141	125	174	37	9	6			-16	-36
1931	-40	-27	-14	20	55	47	41	30	14	8		4
1932		11	105	133	32	67	6				-8	-27
1933	-91	-104	-63	18	83	53	33	8		12	16	
1934	-32	9	69	113	122	107	13	7	6	14		
1935	-24	22	76	82	203	17					-7	-28
1936	-65	-40	-10	50	19	112						
1937	-30	-24	-13	18	54	150	95					11
1938	22	54		-6	147	289	40	6				
1939	10			10			18	10				-49
1940	-54	-27		29	119	248	32					-7
1941	-28	-26		42	119	181	67	-10				-6
1942		28	19	26	156	135	8	-9	-6			
1943		8	12	28	156	85	11	-6				-6
1944	-32	-41	-14	-11		38	8	6				7
1945	15	44	51	40	74	150	72					6
1946		23	24									
1947	-27	-21		16								-18
1948	-22	11		29	38	9	-19					
1949	-19		11	44	62	28					-8	-32
1950	-46	-31	-9	41								
1951			-8	67	156	20						
1952	-20	-19		38	140				-6			
1953				26	13							
1954	-11	28	32	34	8							
1955	-25	-18			51	6						-14
1956	-12		49	73	91	-9		-8				
1957		11	15	21	18							
1958	12	13	12	25	15	192	182	23				
1959	8		10	14	8	66						
1960	-7	-18	-19		32	10		6				
1961			12	27	83	13	13	8				-13
1962				25	-29	96	7					
1963	21		6	28	71							
1964	-24		15	12	69	8					-7	-31
1965	-48	-28		25	134	34						
1966	-32	-14		25	95	6						
1967	-25	-26		95	182			-20				
1968				7	33							
1969	-22	-13		35	140	164					-6	
1970					98							
1971	-24	7										
1972		12	26	29	22							
1973	-15	8		131	208	168	15		-8			-7
1974	-25		14	49	19			-9	-8			
1975	11	8		10	-7	59	7	-8	-12			
1976	11						17	27	20	16	7	47
1977	95	115	135	110	58	24	22	19	8	8		-25
1978		9	49	51	217	204	160	31				

Decreases = 104 No Change = 330 Increases = 250
Differences with base near D1485: Increases = 8 Decreases or No Change = 10

Difference in Chlorides at Old River at Highway 4
Changes which meet screening criteria
Rock Slough/Old River Future Project vs Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922					-6							
1923	-6											
1924	-9	-14				6	7					16
1925		16	10	7	7							
1926				11								-19
1927	-22	-9		13					-6			
1928	-14					-10						
1929	-14				6	11	13	20	20	10		27
1930	44	77	65	37	12		6	7			-9	-20
1931	-20	-10	-9	11	20	24	22	17	9		7	12
1932			19		-9						-6	-11
1933	-41	-60	-39		17	22	13			9	14	11
1934	-22		19	19	18	8	7			11		
1935	-13		16	21	10						-7	-17
1936	-31	-18		7								
1937	-16	-9			-7	-8						8
1938	12	10										
1939				8	10	8	6			8	-7	-29
1940	-30	-16			-6	-7						
1941	-15	-10			-6			-8				
1942	-8	13	7		-6			-11	-8			
1943	-9				-6			-6				
1944	-18	-16	-6	-9	-9		8	8				12
1945	16	9	10	10	6	7	7					
1946		10										
1947	-13											-8
1948				9	7	-9	-14					
1949	-9		11	18	21	7						-19
1950	-24	-13		7								
1951			-12	-7								
1952	-11				-9				-7	-6		
1953				-7	-6							
1954		14	17	20								
1955	-13											-7
1956				-8	-19			-6				
1957	-7		12	15								
1958		6				8						
1959			6									
1960	-7		-12	-8	-7			7				
1961					10	7	9	8				
1962												
1963					6							
1964	-12			7								-18
1965	-26	-15			-6							
1966	-14	-8										
1967	-14	-6						-9				
1968												
1969	-13			-6	20				15		-6	
1970				-10	-8							
1971	-12				-7							
1972	-6	7	14									
1973	-7				-7			-8	-15			-6
1974	-12						-7	-13	-15			
1975						-9	-9	-12	-18			
1976					6	6		9	10	6		28
1977	48	67	62	23	8		8	9				9
1978	24				17	7		13		6		

Decreases = 111 No Change = 459 Increases = 114
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Clifton Court
Changes which meet screening criteria
Rock Slough/Old River Future Project vs Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922				-6			-7					
1923												
1924						6	9	10				
1925		11	6	9								
1926			6	7				9			-7	-17
1927	-15	-6		6					-7			-7
1928						-15						-8
1929						10	22	21	15	8	9	21
1930	38	52	52	25	8		10	11			-8	-16
1931	-15	-8		14	21	20	21	16				
1932			10		-10			8		-11	-22	-24
1933	-31	-44	-21	7	18	16	10					
1934	-9		18	12	12	7	7					
1935			19	13	12			6		-6	-13	-16
1936	-24	-15										-9
1937	-7			-6	-6							6
1938	13	6	-6									
1939				7	6	6		6			-8	-23
1940	-21	-12			-7							-7
1941			-6									-6
1942	-14	6						-14				
1943									-6			-6
1944	-14	-13	-6	-9	-8		14	11	6			8
1945	10			7		7	9					
1946												
1947								8				-7
1948				7	10	-6	-10					
1949		9	15	20	18		6	7			-9	-15
1950	-17	-10										
1951												-6
1952										-7		
1953				-8	-8				-7			-6
1954		8	11	13								-8
1955												-8
1956		8										
1957			11	7					-8			
1958					-6							
1959			7					8				-8
1960	-6	-9	-9	-7	-8		9	11				
1961					7	7	14	14				-7
1962							8	10				
1963					7							-7
1964								7			-8	-18
1965	-21	-11			-8				-6			-6
1966		-7			-6			6				-7
1967			-6									
1968								7				-9
1969	-7			-8	11	6			6		-6	
1970												-6
1971					-10	-7						
1972	-6		10	6					-8			-6
1973	-6							-16	-20		-6	-10
1974	-10	-6				-7	-10	-19	-20			
1975	-10			8		-12	-12	-20	-24			
1976	-6			6	7							20
1977	41	47	45	16		15	17	13	7		6	9
1978	19				10	-13	-8	8		8		

Decreases = 114 No Change = 458 Increases = 112
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Tracy Pumping Plant
Changes which meet screening criteria
Rock Slough/Old River Future Project vs Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922							-9					
1923												
1924						6		6				9
1925	8	11	6	9								
1926				6				10				-10
1927	-11											
1928												
1929						8	14	13	9	14	13	22
1930	31	42	47	20	6		6	12				-11
1931	-12	-8		15	19	17	15	10				8
1932			7		-7					-10	-25	-25
1933	-26	-36	-14	7	15	9						
1934			18	9	9	6						8
1935			17	9	11						-10	-10
1936	-18	-10										-8
1937												
1938	9				6							
1939				6								-14
1940	-15	-10							6			-6
1941											-6	
1942							6					
1943	8											
1944		-7		-8	-7				7			7
1945	9			6		7	8					
1946	9	6			6							
1947								7				
1948				9	9	-6	-12					
1949		9	16	19	17							-10
1950	-13	-8										
1951			12			7						
1952									6			
1953												
1954			9	7								
1955												
1956		8						8				
1957			10						-7			
1958												
1959								8				
1960		-8	-6	-7	-7			8				
1961				8		8	9	13	-7			
1962				7				6				
1963					7	7						
1964			6					9				-10
1965	-14	-7			-6							
1966												
1967								7				
1968												
1969	-7					7				8		
1970												
1971					-7					6		
1972	-6											
1973				-9				-9	-12			
1974									-14			
1975				8		-6		-9	-11			
1976							12	7		14	12	21
1977	37	39	43	18		14	20	19	11		12	23
1978	25	8	7			-12		7				

Decreases = 52 No Change = 525 Increases = 107
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Electrical Conductivity at San Andreas Landing
Changes which meet screening criteria
Rock Slough/Old River Future Project vs Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923		27										
1924	-47	-42			21	23		-23		-24		
1925		61	26	44								
1926				40							-24	-89
1927	-94			59								
1928	-47		22									
1929	-47				31	37	31	60	62		37	182
1930	271	348	226	132	38						-44	-84
1931	-75	-48		53	77	89	71	36	21			
1932	-63		81									-112
1933	-268	-255	-96	31	71	63	23			33		-42
1934	-101	41	74	75	57	26				36		
1935	-75		94	68								-80
1936	-120	-50		33								
1937	-52	-28		-24								42
1938	49	34										
1939				36	36	23					-48	-129
1940	-119	-51										
1941	-55	-35										
1942		64										
1943												
1944	-65	-49		-38								55
1945	41	40	49	41								
1946		50										
1947	-44											-35
1948				32	39	-70	-34					
1949	-21		53	74	68						-23	-87
1950	-94	-44		30								
1951												
1952	-33											
1953												
1954		64	60	66								
1955	-39											-29
1956		23										
1957			52	48								
1958		26										
1959			27									
1960	-23	-29	-39	-21								
1961					39							
1962												
1963												
1964	-33			27							-23	-83
1965	-101	-45										
1966	-72											
1967	-55	-26										
1968												
1969	-36											
1970												
1971	-43											
1972		37	28									
1973	-22											
1974	-35											
1975	23											
1976					23		31	44	43		25	156
1977	241	299	220	72	39							
1978						36	21					

Decreases = 64 No Change = 533 Increases = 87
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Middle R. at Woodward Island
Changes which meet screening criteria
Rock Slough/Old River Future Project vs Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922					-6							
1923												
1924								6				-6
1925		6										
1926											-6	-14
1927	-12							-6	-7			
1928						-10						
1929							12	14	10			13
1930	29	35	30	16			6	8			-6	-12
1931	-10			7	12	11	12	10				-8
1932	-6				-9					-6	-10	-16
1933	-24	-27	-12		10	9	7					-8
1934	-9		10	6								-6
1935	-8		13	9	8						-10	-12
1936	-15	-10			-7							
1937					-6	-9						
1938	7		-7					6	6			
1939											-8	-18
1940	-15	-8			-6							
1941					-8	-11	-7	-7				
1942	-12				-6			-13	-6			
1943	-11							-6				
1944	-12	-8		-6	-6		8	10				
1945												
1946												
1947												
1948						-6	-8					
1949			9	11	10						-8	-12
1950	-10	-6										
1951			-8									
1952					-7							
1953				-6	-7				-6			
1954				6								-6
1955												
1956				-12	-17							
1957	-6											
1958						6	9					
1959												-7
1960	-6	-6	-6	-6	-6			8				
1961							9	9				-7
1962								7				
1963												
1964	-6						6				-6	-13
1965	-16	-9			-6							
1966												-7
1967												
1968												-8
1969	-7				33							
1970				-12	-6							
1971					-10	-6						
1972	-6		6						-6			
1973					-7			-12	-15			-7
1974	-9					-6	-9	-16	-17			
1975	-8					-8	-9	-14	-20			
1976	-6											11
1977	27	29	23									
1978					12	36	44	9		6		

Decreases = 103 No Change = 529 Increases = 52
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

FUTURE CONDITIONS
LOS VAQUEROS RESERVOIR WITH A CLIFTON COURT FOREBAY INTAKE
PROJECT ALTERNATIVE COMPARED TO
NO-ACTION EXISTING CONDITIONS

Difference in Electrical Conductivity at Antioch
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922		270	95				67			53		-377
1923	-351	872	113			-54						-599
1924	-841				366	225		-300				
1925		469		827	194			25	24	-114	-290	
1926			432	776	167			-48		-401	-1172	-1483
1927	-960		613	481	22						-93	-975
1928	-753	555	742	397	75			28			-145	-872
1929	-325	621			638	636	1352	1617	967		368	1838
1930	2321	2830	2324	646	279	88	51			-610	-1430	-1596
1931	-972	-502	735	1487	1714	1616	1160	607				
1932			969	345	70	65	7			-499	-702	-1229
1933	-2374	-2317		1093	1486	971	198					
1934	-516		914	1134	778	290	161			360		
1935			1715	560	27				31		-1076	-2346
1936	-1751	-523	625	347				46	40		-96	-1106
1937	-915			-725	-78			95	112	73	271	640
1938	909	586	76									386
1939	437	269	693	949	619	331	215			-478	-1448	-1971
1940	-1304	-536		54						56	-99	-1062
1941	-873										-114	-826
1942	474	2046	220									-406
1943	844	1138	143								-121	-940
1944	-1342	-625	-408	-1176	-263	-68	-184	-98			319	698
1945	390	586	944	811	75		-45	132	101	124	347	462
1946	296	848	126			221	206	49	22	52	-115	-817
1947	-445	372		-431		51	-74	-66		-203	-591	-496
1948			832	862	1071	348	-76		40	66	-120	-535
1949		1276	1470	1660	1409	186		123	106	-572	-1580	-1931
1950	-1211	-451	736	918	134			170	116	66	415	340
1951		88						75	122	60	-94	-805
1952	-518	256	63									167
1953	177	82					23				-83	-592
1954		1632	1656	418	21				22		-199	-905
1955	-332	195	61	35			94	64			-476	-497
1956		1143	96								-107	-591
1957	-64	909	1759	583	51			76	83			-512
1958	194	627	280									
1959	186	592	1023	171							-327	-655
1960	-523	-1323	-1049	-446	-174	-89	-55					
1961				232	193	313	376	83		-319	-507	
1962				518	151		54					
1963	177	539	371	616	70						-131	-946
1964	-417	427	496	218			188	111		-601	-1482	-1962
1965	-1408	-446										-817
1966	-1463		378	103			64		75	125		-999
1967	-649									31	-54	84
1968	97	37	208	111					70	113	-272	-1052
1969	-420		-176								-136	192
1970	223	38									-230	-946
1971	-760	671	37							45		-671
1972	-382	1651	1002	-89	-158	75	107				-264	-592
1973	-454	267	170					51	24		-339	-1035
1974	-751	203								36	-92	-150
1975	964	559	210	-636	-78					89	-106	-169
1976	234	124	120	343	745	215	603	1171	927	-431		1770
1977	2014	2664	1468	331	268							
1978						30	28				-196	-452

Decreases = 143 No Change = 305 Increases = 236
Differences with base near D1485: Increases = 8 Decreases or No Change = 2

Difference in Electrical Conductivity at Emmaton
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922		152										-223
1923		152									-46	-253
1924	-60	127	-79	128		43	259	246	114	259	-176	-452
1925		163		420							-110	
1926			317	160						-135	-549	-664
1927	-263		82	48								-390
1928		87	95	36							-27	-409
1929	216	192	-71	116	90	176	713	609	313	-165	541	1152
1930	1675	1480	813	93	52		22			-148	-441	-584
1931	-354	-83	442	521	628	531	463	285		112	-162	-368
1932		498	227	51						-220	-432	-921
1933	-1351	-753	293	400	539	186	142			-367	-193	-400
1934		489	390	222	182	106	69		-103	-319	120	-342
1935		268	904	59							-348	-901
1936	-513	-268	370	38								-484
1937	-68			-230							119	355
1938	466	81										56
1939	49		104	274	163	101		69		-212	-759	-917
1940	-484	-136	107									-413
1941												-375
1942		280										-229
1943	47	120										-386
1944	-250	-143	-132	-280	-24				2		205	393
1945	170	145	183	202						21	108	117
1946	182	218				22	36				-30	-374
1947	143	125	-49	-143						-70	-267	-163
1948			576	179	446	41					-24	-230
1949	238	529	501	602	372			29		-196	-684	-775
1950	-420	-225	468	141							118	
1951												-295
1952	61	75										
1953												-240
1954		240	276	41							-31	-393
1955	193					24	22			-37	-291	-191
1956	270	448										-219
1957	-29	125	412	67								-200
1958	45	81	23									-58
1959	24	55	245						5		-172	-203
1960	-133	-603	-200	-123	-21		27					
1961			-46	135	26	65	123	28		-121	-191	
1962			-66	253	21		25					49
1963		49	24	71								-365
1964		42	107	23		60	70	25	9	-212	-572	-768
1965	-460	-102										-372
1966	-134		44								-58	-453
1967	126	-73									-30	
1968			23								-143	-421
1969	79		-27								-38	26
1970	24										-72	-336
1971	-50	102										-271
1972	-77	269	105								-51	-206
1973	-107	36									-77	-332
1974	-152											-37
1975	127	47		-89							-34	-38
1976	22			141	215		174	372	281	-249	412	1042
1977	1347	1148	158		-104	101	102				298	
1978	-284										-40	-117

Decreases = 128 No Change = 389 Increases = 167
Differences with base near D1485: Increases = 5 Decreases or No Change = 9

Difference in Electrical Conductivity at Jersey Point
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922			39								21	
1923	-117	220	28								66	
1924	-340	-221			165	131	-69	-191	-97	-151		
1925		212	94	146	62						-27	
1926				246	77						-158	-423
1927	-360		146	259								-93
1928	-320	120	170	92	30						28	-71
1929	-347				244	191	106	345	317	109	85	692
1930	934	1142	792	431	122	63				-44	-276	-428
1931	-348	-241	-74	282	392	439	319	175	101		115	
1932	-162		395							78	-53	-369
1933	-972	-1006	-488	176	344	365	86			204	187	
1934	-308		241	413	301	115	54		100	269	55	
1935	-232		329	248	21					24	-26	-462
1936	-559	-162		144								-73
1937	-371	-115		-118	-22					21	62	205
1938	183	187	28									98
1939	75	26	127	235	201	116	120			89	-234	-598
1940	-457	-201		31								-90
1941	-385	-146										-105
1942	190	472	55									-63
1943	156	179	24									-88
1944	-422	-256	-83	-220	-70		-25				85	273
1945	170	222	317	245	25							115
1946		284	41			35	38				31	-67
1947	-332		68		41	42	-22	-21			-74	-144
1948				190	166	-175	-66				23	-51
1949	-159	112	269	363	376	66			25		-126	-480
1950	-419	-174		194	56							100
1951		25										-45
1952	-257											35
1953												-28
1954		442	415	280							24	-69
1955	-306		29			-31						-148
1956	-101	123	28									-62
1957		96	380	276	69							39
1958	94	181	69									
1959	30	75	220	86							48	-82
1960	-132	-74	-271	-74	-35	-26	-40				39	74
1961					146	62				66	-75	
1962					39							
1963	67	75	76	69								-66
1964	-242	76	78	132	31	-102	-114				-157	-460
1965	-436	-178										-77
1966	-485	-50	31	25						54	74	-64
1967	-363	-86										36
1968			21	44						46	96	-72
1969	-257											35
1970	27											-87
1971	-290	104										-51
1972	-52	306	221	49	-28	23	31					-67
1973	-95	54										-110
1974	-196	89										
1975	216	90	25	-55							33	
1976	54			49	140	123	178	348	392			604
1977	722	1079	891	290	183							
1978						36	29					-73

Decreases = 113 No Change = 386 Increases = 185
Differences with base near D1485: Increases = 2 Decreases or No Change = 7

Difference in Chlorides at Old River at Rock Slough
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922					-6							
1923	-10	11										
1924	-22	-24			11	13		-6				
1925		29	14	15	12							
1926				20	10						-8	-36
1927	-41	-10	8	26								-6
1928	-26		11	7		-7						
1929	-27				15	20	15	31	33	19	12	65
1930	108	134	109	60	20	7					-18	-38
1931	-38	-24	-10	24	38	45	38	25	13		9	
1932			36		-7						-9	-31
1933	-98	-117	-60	10	33	38	16	6		14	15	
1934	-31		35	37	33	15	9		8	17		
1935	-24		34	35	9						-6	-32
1936	-60	-27		15								-6
1937	-29	-15	-6	-9	-9	-9						17
1938	26	18			8			8	7			
1939				18	20	13	9			9	-11	-53
1940	-54	-25	-6			-6						-8
1941	-28	-16	-6		-8	-28	-16	-6				-7
1942		30	10		-6			-10				
1943		8			-6							-6
1944	-32	-28	-9	-16	-12		6				6	24
1945	27	19	25	23	7	6						8
1946	10	21	8									
1947	-24	-6										-14
1948				17	17	-17	-17					
1949	-13	8	24	37	38	10					-7	-37
1950	-46	-23		15								
1951			-18	-6								
1952	-18	-6			-8				-12			
1953												
1954		31	32	35								
1955	-24											-14
1956	-8	11		-19	-30			-8				
1957	-8		26	29	8							
1958	7	13	6			8	17		-8			
1959			14	9								-7
1960	-12	-8	-21	-9								
1961					18	9	6					-7
1962												
1963			6		7							
1964	-20			13			-9				-9	-34
1965	-46	-23										
1966	-33	-14									6	
1967	-28	-11						-15				
1968												
1969	-21			-6	18		-8		10			
1970				-8								-6
1971	-22											
1972	-7	16	21	6								
1973	-11				-7			-6	-9			-7
1974	-18							-8	-7			
1975	9	7				-7		-7	-12			
1976					12	12	15	28	35	19	7	55
1977	80	112	110	41	20	14	11	9	7			
1978					16	48	84	12				

Decreases = 120 No Change = 427 Increases = 137
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Rock Slough @ Contra Costa Canal
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922	-6	-11	12	42	90	44	-8					
1923	-17	16	31	118	163	40						
1924	-17	-34	-8	11	10	13						4
1925		55	67	86	134	206						
1926			8	29	68	144					-7	-34
1927	-47		15	24	60	92						-6
1928	-30		24	32	80	34	7					
1929	-28	-18		15	15	22	18	31	31	21	13	34
1930	91	132	136	122	172	34	10				-16	-36
1931	-40	-27	-14	20	55	47	41	33	15		9	5
1932		12	106	110	37	97	9				-8	-27
1933	-91	-103	-63	19	83	53	33	8		10	16	1
1934	-30	10	70	113	122	107	13	7	6	15		
1935	-23	22	77	82	203	29					-7	-27
1936	-65	-40	-10	51		93						
1937	-30	-25	-13	13	17	127	83					12
1938	22	44		-6	133	280	41	6				
1939	10			7	10		19	10		8		-48
1940	-54	-28		30	119	249	26					-7
1941	-28	-25	17	14	123	68	13					-6
1942		28	25	31	161	139	8	-9	-6			
1943		9	12	29	147	77	10	-6				
1944	-32	-41	-14	-14	18	36	7	7				11
1945	17	46	42	41	81	154	71					6
1946		23	26									
1947	-27	-21		17								-16
1948	-18	13		30	38	9	-19					
1949	-18		11	45	62	52	35				-8	-32
1950	-47	-31	-9	32	25	43						
1951			-9	75	159	19						
1952	-20	-19		40	74	-7			-8			
1953				26	13							
1954	-11	28	33	34	8							
1955	-25	-18		6	61	8						-14
1956	-10		50	48	24	-9		-8				
1957			16	9	19							
1958	12	13	12	26		188	125	14				
1959	8		11	14	14	74						
1960	-7	-18	-19	-7	25	8	7	6				
1961	6		13	27	40	11	13	7				-9
1962			8	27	14	107	7					
1963	21		6	28	115							
1964	-24	9	18	13	70	8					-7	-31
1965	-48	-28		21	130	33						
1966	-32	-12		25	95	6						
1967	-24	-26		-11	138		9	-19		8		
1968				7	33							
1969	-22	-12		30	149	189					-6	
1970					168	15						
1971	-24	10										
1972		12	26	29	22							
1973	-14	13		121	202	170	13		-9			-7
1974	-25			35	18			-9	-7			
1975	12	8			-7	59	7	-8	-12			
1976	11				-12		17	28	30	24	8	37
1977	76	97	122	103	55	23	22	19	8	8		-25
1978		9	49	51	217	204	87	29				

Decreases = 103 No Change = 323 Increases = 258
Differences with base near D1485: Increases = 9 Decreases or No Change = 9

Difference in Chlorides at Old River at Highway 4
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922					-8	-6						
1923												
1924	-9	-14				7	8					16
1925		17	11	7	6							
1926				11								-19
1927	-21	-8		13					-6			
1928	-14					-10						
1929	-14				6	11	13	20	20	11		29
1930	49	76	63	37	12		6	6			-9	-20
1931	-20	-10	-8	11	20	25	22	19	10		9	15
1932			20		-10						-6	-11
1933	-40	-59	-39		18	23	13			11	16	14
1934	-17		20	19	18	9	8			13		9
1935			17	20	10						-7	-17
1936	-30	-17		7	-9							
1937	-16	-9			-10	-11						8
1938	13	10										
1939				8	10	9	6			9		-28
1940	-30	-15			-8	-8		-6				
1941	-15	-9			-9		-6	-7				
1942	-8	12	6		-7			-11	-8			
1943	-9				-7			-6				
1944	-18	-16	-6	-9	-10		8	9				12
1945	17	9	11	11		6	7					
1946		10										
1947	-13											-8
1948				9	8	-9	-14					
1949	-8		12	19	22	7						-19
1950	-24	-13		7								
1951			-12	-8								
1952	-11			-8	-9				-7	-7		
1953				-7	-6							
1954		14	17	20								
1955	-13											-7
1956				-12	-21			-6				
1957	-8		12	15								
1958					-8	6	6					
1959			6									
1960	-7		-12	-7	-6			7				
1961					10	8	9	9				-6
1962												
1963					6							
1964	-12			6								-18
1965	-26	-15		-6	-6							
1966	-14	-8										
1967	-14	-6						-9	6			
1968												
1969	-12			-8	29				15		-6	
1970				-14	-8							
1971	-12				-7							
1972	-6	7	14									
1973	-6				-10			-8	-15			-6
1974	-12						-7	-13	-15			
1975						-9	-9	-12	-18			
1976					7	7		13	16	10		27
1977	38	59	58	22	8		9	9		6		11
1978	27				15	21	8	13		6		

Decreases = 116 No Change = 451 Increases = 117
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Clifton Court
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922				-7			-7					
1923												
1924						6	9	9				
1925		12	6	9								
1926			6	7				8			-7	-17
1927	-15	-6		6					-7			-7
1928						-15						-9
1929						10	21	20	15	8	10	22
1930	41	52	51	24	7		10	11			-8	-16
1931	-15	-8		14	21	20	22	16				
1932			10		-11			8		-11	-22	-24
1933	-30	-44	-20	7	18	16	10					
1934			18	12	12	7	7					
1935			20	12	12			6		-6	-13	-16
1936	-24	-15				-6						-9
1937	-7			-7	-6							6
1938	14		-6	-6								
1939				7	6	6					-7	-23
1940	-21	-12			-8							-7
1941			-6									-7
1942	-14	6						-14				
1943									-6			-6
1944	-14	-13	-6	-9	-9		14	11	6			8
1945	11			8		7	9					
1946												
1947								8				-7
1948				7	10	-7	-10					
1949		10	15	20	18		6	7			-9	-15
1950	-17	-10										
1951												-6
1952										-7		
1953				-8	-8				-7			-6
1954		8	11	13								-8
1955												-8
1956		8										-6
1957			11	7					-8			
1958					-6							
1959			6					7				-8
1960	-6	-9	-9	-7	-8		9	11				
1961					7	7	14	14				-7
1962							8	10				
1963					6							-7
1964								7			-8	-17
1965	-21	-11			-8				-6			-6
1966		-7			-6			6				-7
1967			-6	-6								
1968								7				-8
1969	-7			-9	14				6		-6	
1970												-6
1971	-6				-10	-7						
1972	-6		10						-8			-6
1973	-6							-16	-20		-7	-11
1974	-10	-7				-7	-10	-19	-20			
1975	-10			9		-12	-12	-20	-24			
1976	-6			6	7				6	7	6	19
1977	35	41	42	15		13	16	12				10
1978	20				10	-11	-7	8		8		

Decreases = 118 No Change = 457 Increases = 109
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Tracy Pumping Plant
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922							-9					
1923												
1924						6		6				9
1925	8	12	6	9								
1926								10				-10
1927	-10											
1928												
1929						8	14	13	9	15	14	22
1930	33	41	46	19	6		6	12				-11
1931	-11	-7		15	19	17	16	10				9
1932			7		-8					-10	-25	-25
1933	-25	-36	-14	7	15	9						7
1934			19	8	9	6						9
1935			18	8	11						-9	-10
1936	-18	-10										-8
1937												
1938	10				6							
1939				6								-13
1940	-15	-9							6			-6
1941											-6	-6
1942							6					
1943	7											
1944		-7		-8	-7				8			7
1945	10			7		7	8					
1946	9	6			6							
1947								7				
1948				9	9	-6	-12					
1949		10	16	20	17							-10
1950	-13	-8										
1951			12			7						
1952									6			
1953												
1954			9	7								
1955												
1956		9						8				
1957			10						-7			
1958												
1959								8				
1960		-8	-6	-7	-7			8				
1961				8		9	9	13	-6			
1962				7				6				
1963					7	7						
1964			6					8				-10
1965	-13	-7	-6		-6							
1966												
1967								7				
1968												
1969	-6					7				8		
1970												
1971					-7					6		
1972	-6											
1973				-10				-9	-12			
1974									-14			
1975				8		-6		-9	-11			
1976							12	8	7	16	12	20
1977	33	34	40	17		13	20	19	9		12	23
1978	25	9	7			-11		7				

Decreases = 54 No Change = 522 Increases = 108
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Electrical Conductivity at San Andreas Landing
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923		29										
1924	-47	-42			23	25		-23		-23		
1925		59		44								
1926				40							-24	-89
1927	-93			59								
1928	-47		21									
1929	-47				33	35	30	59	63	22	41	190
1930	286	332	220	130	37						-43	-85
1931	-75	-48		53	77	89	72	39				
1932	-62		81									-112
1933	-268	-255	-96	31	71	64	23			29		
1934	-99	42	75	75	57	26				38		
1935	-76		94	68								-80
1936	-120	-50		33								
1937	-52	-29		-25								40
1938	49	34										
1939				36	36	23					-43	-127
1940	-116	-48										
1941	-55	-36										
1942		62										
1943												
1944	-65	-49		-36								58
1945	44	42	52	44								
1946		49										
1947	-43											-31
1948				33	39	-70	-34					
1949			50	74	68						-23	-86
1950	-94	-44		30								
1951												
1952	-34											
1953												
1954		65	60	66								
1955	-39											-29
1956		27										
1957			51	49								
1958		26										
1959			27									
1960	-23	-29	-39									
1961					41							
1962												
1963												
1964	-35			27							-23	-83
1965	-101	-44										
1966	-72											
1967	-53	-27										
1968												
1969	-35											
1970												
1971	-43											
1972		36	28									
1973	-21											
1974	-36	21										
1975	23											
1976					23		31	58	70	21	30	148
1977	189	264	205	68	37							
1978						36						

Decreases = 61 No Change = 536 Increases = 87
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Middle R. at Woodward Island
Changes which meet screening criteria
Rock Slough/Clifton Court Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922					-8							
1923												
1924								6				-8
1925	-6											
1926											-6	-14
1927	-12							-6	-7			
1928						-11						-6
1929							12	14	10			13
1930	30	34	28	15			6	8			-6	-12
1931	-10			7	12	11	12	10				-8
1932	-6				-10					-6	-10	-16
1933	-24	-27	-12		10	9	7					-9
1934	-9		10	6								-6
1935	-7		13	8	8						-10	-12
1936	-15	-10			-10							-6
1937	-6				-8	-11						
1938	7		-7					6	6			
1939											-8	-18
1940	-15	-8			-8	-6						
1941					-10	-13	-8	-7				
1942	-12				-6			-13	-6			
1943	-11							-6				
1944	-12	-8		-6	-7		8	10				
1945												
1946												
1947												
1948						-6	-8					
1949			9	11	10						-8	-12
1950	-11	-6										
1951			-8									
1952				-8	-7							
1953				-7	-7				-6			
1954				6								-6
1955												-6
1956				-16	-17							
1957	-6											
1958					-8		6					
1959												-7
1960	-6	-6	-6	-6	-6			8				
1961							9	9				-7
1962								7				
1963												
1964	-6						6				-6	-13
1965	-16	-9			-6							
1966												-6
1967												
1968												-7
1969	-7			-7	21							
1970				-15	-6							
1971					-10	-6						
1972	-6		6									
1973					-9			-12	-15			-8
1974	-10					-7	-9	-16	-17			
1975	-8					-8	-9	-14	-20			
1976	-6											11
1977	23	25	20									
1978					11	26	43	9		6		

Decreases = 111 No Change = 523 Increases = 50
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

FUTURE CONDITIONS
DESALINATION
PROJECT ALTERNATIVE COMPARED TO
NO-ACTION EXISTING CONDITIONS

Difference in Electrical Conductivity at Antioch
Changes which meet screening criteria
Desalination Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922		277	94				65			51		-423
1923	-395	850	110			-56						-601
1924	-832				275			-256				
1925		451		806	193			22	23	-114	-293	
1926			431	789	170		-40	-48		-383	-1174	-1507
1927	-965		609	469	21						-93	-971
1928	-752	518	743	402	75			29			-149	-879
1929	-338	610			575	613	1355	1630	976		382	1952
1930	2526	2990	2358	511	213	75	50			-582	-1389	-1554
1931	-940	-483	747	1494	1713	1622	1180	627	299			
1932			1001	349	71	86	25			-525	-727	-1249
1933	-2398	-2325		1096	1497	969	195					
1934			906	1135	788	313	186			391		
1935			1733	561	25				31		-1072	-2337
1936	-1749	-542	613	361				42	43	54		-1034
1937	-854			-720	-82			92	116	73	262	614
1938	885	589	78									400
1939	444	263	689	950	615	328	218			-482	-1435	-1970
1940	-1295	-529		57						58	-95	-1062
1941	-870										-115	-824
1942	492	2001	217									-413
1943	851	1125	143								-134	-951
1944	-1354	-637	-415	-1221	-277	-69	-185	-81			270	720
1945	469	726	1011	775	73		-45	133	102	124	341	465
1946	323	849	131			183	165	46	23	51	-121	-811
1947	-435	380		-424			-106	-73		-203	-601	-528
1948			838	871	1085	355	-78		40	66	-117	-532
1949		1275	1467	1669	1405	186		120	103	-571	-1579	-1926
1950	-1204	-456	730	920	126			170	117	70	420	343
1951		90						74	158	123	-83	-801
1952	-513	261	67									169
1953	178	79					23				-80	-589
1954		1599	1645	416	21				22		-170	-842
1955	-295	205	82	33			91	67			-516	-535
1956		1123	102								-108	-589
1957	-61	908	1764	595	48			75	82			-507
1958	210	607	279									
1959	185	576	1010	168							-343	-655
1960	-525	-1326	-1054	-526	-213	-91	-54					
1961				226	190	290	357	113		-312	-506	
1962				525	161		49					
1963	182	529	355	601	68						-128	-946
1964	-419	409	486	216			188	112		-593	-1477	-1957
1965	-1400	-435										-815
1966	-1454		374	101			66				-165	-1035
1967	-674									33		95
1968	99	34	202	111							-334	-1081
1969	-442		-178								-119	204
1970	227	35									-246	-959
1971	-760	658	37							45		-669
1972	-376	1660	986	-89	-158	75	106				-284	-589
1973	-441	274	181					51	24		-337	-1036
1974	-761	197								40	-102	-153
1975	963	554	190	-641	-78					90	-105	-151
1976	242	122	120	340	724	194	585	1047	719	-472		1854
1977	2429	2908	1575	366	281							
1978				36		29	28				-193	-452

Decreases = 142 No Change = 309 Increases = 233
Differences with base near D1485: Increases = 8 Decreases or No Change = 2

Difference in Electrical Conductivity at Emmaton
Changes which meet screening criteria
Desalination Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922		148										-230
1923	-53	149									-48	-252
1924	-57	127	-79	126			238	235		172	-184	-460
1925		145		410							-111	
1926			314	162						-134	-551	-621
1927	-305		82	47								-389
1928		81	94	37							-28	-411
1929	211	187	-70	116	79	170	712	611	305	-170	512	1189
1930	1659	1383	805	72			21			-148	-439	-577
1931	-348	-79	444	521	626	530	466	279		108	-172	-355
1932		488	231	52						-225	-439	-932
1933	-1363	-761	291	384	542	185	139			-376		-395
1934		445	379	221	184	113	71		-108	-320	117	-262
1935		276	905	59							-347	-900
1936	-514	-274	365	40								-475
1937	-52			-230							110	342
1938	455	81										58
1939	50		103	274	162	98		70		-216	-759	-918
1940	-486	-128	111									-413
1941												-374
1942		280										-231
1943	48	119									-21	-388
1944	-256	-150	-138	-286	-24						186	385
1945	163	176	201	193						21	106	117
1946	181	213					31				-31	-377
1947	125	123	-50	-142						-70	-271	-182
1948			575	181	450	42					-24	-227
1949	239	528	497	606	376			29		-196	-684	-775
1950	-421	-230	463	141							120	
1951												-295
1952	62	75										
1953												-239
1954		235	273	41							-29	-385
1955	151					22	21		3	-39	-300	-204
1956	259	441										-219
1957	-29	125	411	69								-200
1958	47	77	23									-58
1959	23	54	242						5		-175	-205
1960	-135	-609	-198	-137	-24		27					
1961			-49	132	24	58	119	31	3	-118	-192	
1962			-63	255	23		23					52
1963		49	23	69								-364
1964		40	105	22		61	70	25	9	-212	-571	-767
1965	-460	-101										-372
1966	-131		44								-74	-463
1967	108	-75									-29	
1968			22								-153	-428
1969	71		-26								-37	28
1970	24										-72	-339
1971	-77	100										-270
1972	-76	271	103								-55	-208
1973	-105	37									-77	-332
1974	-154											-37
1975	128	47		-89							-34	-37
1976	23			139	209		171	329	191	-272	411	1073
1977	1479	1351	194		-102	106	101				281	
1978	-289										-40	-118

Decreases = 129 No Change = 392 Increases = 163
Differences with base near D1485: Increases = 6 Decreases or No Change = 8

Difference in Electrical Conductivity at Jersey Point
Changes which meet screening criteria
Desalination Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922			35									
1923	-130	211	27								61	
1924	-336	-219			133	90	-86	-176	-105	-140		
1925		207		140	60						-27	
1926				251	78					34	-157	-422
1927	-350		145	249								-91
1928	-318	104	169	93	30						28	-73
1929	-351				218	181	105	348	323	142	103	734
1930	1018	1208	795	-51		46				-37	-267	-419
1931	-339	-234		285	393	442	327	180	121		111	
1932			406							80	-57	-371
1933	-977	-1012	-487	182	347	369	85			209	126	
1934	-257		232	420	303	120	63		112	293	68	
1935	-207		336	246						25	-25	-459
1936	-557	-169		150								-55
1937	-354	-106		-116	-23					22	58	200
1938	181	187	30									101
1939	77	24	126	235	200	115	123			105	-208	-604
1940	-454	-195		33								-90
1941	-384	-142										-104
1942	195	461	55									-65
1943	158	175	24									-91
1944	-435	-265	-86	-244	-75		-25				69	286
1945	223	290	350	233	24							116
1946		288	42			29	28				30	-69
1947	-331		74			22	-29	-23			-77	-156
1948				201	173	-172	-68				24	-48
1949	-160	108	267	370	384	66			24		-124	-472
1950	-417	-174		195	52							103
1951		25								26	25	-42
1952	-256											34
1953												
1954		426	412	280							29	-54
1955	-293		35			-34				45		-159
1956	-110	123	29									-61
1957		96	382	281	64							41
1958	98	173	68									
1959	29	71	216	85							46	-81
1960	-131	-73	-270	-102	-60	-28	-40			29		64
1961					143	55				70	-74	
1962					42							
1963	69	71	72	65								-65
1964	-242	72	77	131	31	-100	-114				-154	-456
1965	-432	-173										-77
1966	-483	-52	31	24							42	-78
1967	-372	-89										37
1968				44							69	-83
1969	-264		-24									38
1970	28											-91
1971	-288	100										-50
1972	-50	309	215	49	-28	22	31			31		-70
1973	-90	55										-109
1974	-199	86										
1975	217	90	22	-56							34	
1976	55			49	136	117	175	315	317	96		644
1977	910	1228	959	310	190							
1978						35	29					-72

Decreases = 112 No Change = 390 Increases = 182
Differences with base near D1485: Increases = 2 Decreases or No Change = 7

Difference in Chlorides at Old River at Rock Slough
Changes which meet screening criteria
Desalination Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922					-6							
1923	-12	9										
1924	-23	-25			9	8		-9	-9	-12		
1925		23	10	13	10							
1926				19	10						-9	-37
1927	-42	-10	8	24								-7
1928	-26		10	7		-7						
1929	-29				13	18	14	30	31	17	9	63
1930	108	134	106		-11						-18	-38
1931	-39	-25	-10	23	37	43	37	22	11			
1932	-25		34		-8						-10	-33
1933	-102	-120	-62	10	32	37	15			12	11	
1934	-40		29	36	32	14	8		6	15		
1935	-30		32	34	9						-6	-32
1936	-60	-29		14								
1937	-28	-15	-7	-9	-10	-10						15
1938	23	17			7			7	7			
1939				17	19	12	9			9	-12	-54
1940	-56	-27	-7			-7						-8
1941	-28	-17	-7		-8	-27	-15	-6				-7
1942		29	10		-6			-10				
1943		8			-6							-6
1944	-34	-30	-10	-17	-13							22
1945	27	23	29	22	7	6						7
1946	9	20	8									
1947	-25	-7										-17
1948				16	17	-17	-17					
1949	-13	7	23	36	39	11					-8	-38
1950	-47	-24	-7	15								
1951			-18	-6								
1952	-18	-6			-8				-12			
1953												
1954		30	32	35								
1955	-23											-16
1956	-10	9		-20	-30			-8				-6
1957	-8		26	29	8							
1958	6	13	6		-6		10		-8			
1959			14	9								-8
1960	-13	-9	-22	-11	-8							
1961					17	9						-9
1962												
1963			6		6							
1964	-21			13			-9				-10	-35
1965	-48	-24										-6
1966	-33	-14										
1967	-30	-13					-6	-16				
1968												
1969	-23			-6	17		-10		10	-6		
1970				-8								-6
1971	-23											
1972	-7	16	21	6								
1973	-12				-7			-6	-9			-8
1974	-19							-8	-8			
1975	8	7				-7		-7	-12			
1976					12	11	14	23	26	15		53
1977	94	127	117	42	19	11	8	7				
1978					15	46	80	12				

Decreases = 130 No Change = 429 Increases = 125
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Rock Slough @ Contra Costa Canal
Changes which meet screening criteria
Desalination Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922				-9	-14	-9	-8					
1923	-12	7		-10								
1924	-20	-26			6	8		-9	-9	-11		4
1925		20	10	7								
1926				16							-8	-34
1927	-43	-15		19	-8				-6			-6
1928	-24		9			-9						
1929	-27	-6			9	18	16	27	31	18	7	57
1930	105	130	109		-18		6				-16	-36
1931	-39	-25	-12	21	37	43	37	22	11			5
1932	-23		24		-18						-9	-26
1933	-94	-121	-68		30	36	15			10	13	
1934	-38		27	30	25	14	7			13		
1935	-29		28	17	9						-7	-28
1936	-59	-31		8	-27	-8						
1937	-27	-15	-7	-12	-22	-22	-9					13
1938	24	16		-6	-15			6				
1939				17	19	12	6			7	-9	-51
1940	-58	-29	-8	-11	-31	-13	-6					-8
1941	-26	-17	-11	-21	-18	-10	-20	-9				-6
1942	-6	27	12	-15	-11			-9	-6			
1943	-8	7		-13	-10			-6				-6
1944	-30	-31	-12	-16	-21	-6	8					21
1945	27	20	26	20		6	6					6
1946	10	16	8									
1947	-25	-8										-16
1948	-9			14	18	-12	-21					
1949	-13		22	33	40	11					-9	-34
1950	-48	-27	-7	9								
1951			-22	-17								
1952	-17	-7		-25	-13	-10			-8	-7		
1953				-11								
1954	-6	27	30	35								
1955	-22			-7								-16
1956	-11	7	-6	-22	-47	-8		-8				-6
1957	-10		23	30	8							
1958		12	6	-9	-28							
1959			13	10								-8
1960	-13	-8	-21	-13	-13	-7						
1961					14	10	10					-9
1962					-14							
1963												
1964	-19			10			-6				-8	-33
1965	-48	-26	-10	-11	-6							-6
1966	-31	-18										
1967	-28	-14	-8	-29	-9		-6	-23				
1968												
1969	-22		-6	-25			-8				-7	
1970				-22	-11							-6
1971	-22		-6									
1972	-9	13	22									
1973	-12			-26	-19			-6	-10			-7
1974	-19			-8				-9	-9			
1975	6	7				-13	-10	-8	-12			
1976					12	10	11	21	24	16		48
1977	90	121	118	45	19	14	8	7				2
1978	1		1		10	19	43	15				

Decreases = 176 No Change = 396 Increases = 112
Differences with base near D1485: Increases = 6 Decreases or No Change = 12

Difference in Chlorides at Old River at Highway 4
Changes which meet screening criteria
Desalination Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922					-8							
1923	-7											
1924	-10	-15								-14	-7	
1925	-12	9	6									
1926				10							-6	-21
1927	-23	-8		12					-6			
1928	-15					-10						
1929	-15					9	11	18	17	7		19
1930	40	71	57		-13		6	7			-10	-21
1931	-22	-12	-10	10	19	22	20	14	6			
1932	-21		16		-10						-7	-13
1933	-45	-63	-41		17	21	11			6		
1934	-28		13	17	16	7	6			7	-6	
1935	-23		14	19	10						-8	-17
1936	-32	-19		7	-9							
1937	-17	-10		-6	-10	-12						
1938	9	9										
1939				8	10	7					-8	-30
1940	-32	-17	-6		-8	-8						
1941	-16	-11	-6		-9		-6	-7				
1942	-9	12	6		-7			-11	-8			
1943	-9				-7			-6				
1944	-20	-18	-7	-9	-10		8	8				7
1945	13	9	13	11		6	6					
1946		8										
1947	-14											-11
1948	-7			8	7	-9	-14					
1949	-9		10	17	21	7						-20
1950	-26	-15	-7	7								
1951			-12	-8								
1952	-12			-8	-9				-7	-7		
1953				-7	-6							
1954		13	16	20								
1955	-13											-10
1956	-6			-11	-20			-6				
1957	-7		12	15								
1958					-8							
1959												-6
1960	-8		-13	-8	-8			7				
1961					9	7	9	8				-8
1962												
1963					6							
1964	-13			6							-6	-20
1965	-28	-16		-6	-6							
1966	-15	-8										
1967	-16	-8			-6			-10				
1968												
1969	-14			-8	27				15		-6	
1970				-14	-8							
1971	-13				-7							
1972	-7	6	14									
1973	-7				-10			-8	-15			-7
1974	-13						-7	-13	-15			
1975						-9	-9	-12	-18			
1976					6			8	9			20
1977	41	63	59	21	6						-11	
1978					15	20		12		6		

Decreases = 134 No Change = 461 Increases = 89
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Clifton Court
Changes which meet screening criteria
Desalination Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922				-6			-7					
1923												
1924							8	7			-10	-6
1925	-9			8								
1926				6				9			-8	-18
1927	-16	-6		6					-7			-7
1928						-15						-9
1929						9	21	20	13	6	6	18
1930	36	49	48		-13		10	11			-9	-16
1931	-15	-9		14	21	19	20	14			-10	-6
1932	-9		8		-11			8	6	-11	-23	-25
1933	-33	-46	-22	7	18	15	9				-6	
1934	-16	-8	15	11	11	7	6			-7		-6
1935	-11		18	12	13			6		-6	-13	-16
1936	-24	-16				-6						-9
1937	-7			-7	-6							
1938	12											
1939				7	6	6					-8	-24
1940	-23	-13			-9							-7
1941			-6									-6
1942	-14	6						-14				
1943									-6			-6
1944	-15	-14	-7	-9	-9		14	11	6			
1945	8		6	8		7	9					
1946												
1947								8				-9
1948				6	9	-7	-10					
1949		9	14	20	18		6	7			-9	-16
1950	-18	-11										
1951												-6
1952										-7		
1953				-8	-8				-7			-6
1954		8	11	12								-8
1955												-9
1956		7										
1957			11	7					-8			
1958					-6							
1959			7					8				-8
1960	-6	-9	-9	-7	-9		9	11				
1961					6	7	14	14				-9
1962							8	10				
1963					7							-7
1964	-6							7			-8	-18
1965	-22	-12			-8				-6			-6
1966		-7			-6			6				-8
1967	-6		-6	-6								
1968								7				-9
1969	-8			-9	13				6		-6	
1970												-6
1971	-6				-10	-7						
1972	-6		10	6					-8			-6
1973	-6							-16	-20		-7	-10
1974	-10	-7				-7	-10	-19	-21			
1975	-10			9		-12	-13	-20	-24			
1976	-6			6	7							16
1977	36	44	44	14		13	16	11				
1978	12				11	-12	-8	7		8		

Decreases = 130 No Change = 454 Increases = 100
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Tracy Pumping Plant
Changes which meet screening criteria
Desalination Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922							-9					
1923												
1924									-6			
1925		7		8								
1926								10				-11
1927	-12											
1928												
1929						7	13	13	7	13	12	19
1930	30	39	44		-9		6	12			-6	-12
1931	-12	-8		15	19	16	14	8				
1932			7		-8					-10	-25	-26
1933	-27	-38	-15	7	15	9						
1934			16	8	8							
1935			16	8	11						-10	-10
1936	-19	-10										-8
1937												
1938	8				6							
1939				6								-15
1940	-16	-10							6			-6
1941											-6	
1942							6					
1943	8											
1944		-8	-6	-8	-7				7			
1945	7			7		7	8					
1946	8	6			6							
1947								7				-6
1948				9	9	-6	-12					
1949		9	15	19	17							-11
1950	-14	-9										
1951			12			7						
1952									6			
1953												
1954			9	7								
1955												-6
1956		8						9				
1957			10						-7			
1958												
1959								8				
1960		-9	-7	-7	-7	-6		8				
1961				7		8	8	13	-7			
1962				7				6				
1963					7	7						
1964			6					9				-10
1965	-15	-7			-6							
1966												
1967								6				
1968												
1969	-7					7				8		
1970												
1971					-7					6		
1972	-6											
1973				-10				-9	-12			
1974									-14			
1975				8		-6		-9	-11			
1976							11	7		13	10	18
1977	33	36	42	17		13	19	18	8		7	19
1978	20					-12		7				

Decreases = 59 No Change = 532 Increases = 93
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Electrical Conductivity at San Andreas Landing
Changes which meet screening criteria
Desalination Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923	-21	27										
1924	-46	-41						-23		-25		
1925		55		42								
1926				41							-24	-88
1927	-91			56								
1928	-47											
1929	-48				29	33	30	59	63	26	44	200
1930	300	344	220	-43							-42	-83
1931	-74	-46		55	79	89	74	39				
1932	-61		83									-113
1933	-270	-257	-97	32	72	64	23			35		-42
1934	-91		68	75	57	27				38		
1935	-73		96	68								-79
1936	-119	-47		35								
1937	-49	-27		-24								38
1938	49	35										
1939				36	36	23					-39	-126
1940	-116	-47										
1941	-55	-35										
1942		61										
1943												
1944	-67	-53		-39								58
1945	52	55	60	43								
1946		50										
1947	-44											-37
1948				33	40	-69	-35					
1949			53	77	70						-23	-86
1950	-94	-44		31								
1951												
1952	-33											
1953												
1954		62	59	66								
1955	-38											-31
1956		26										
1957			51	49								
1958		25										
1959			26									
1960	-23	-29	-39	-21								
1961					39							
1962												
1963												
1964	-34			27							-23	-82
1965	-100	-43										
1966	-71											
1967	-56	-28										
1968												
1969	-37											
1970												
1971	-43											
1972		37	28									
1973												
1974	-36	21										
1975	23											
1976					22		31	51	56	22	31	155
1977	240	306	225	73	39							
1978						36	21					

Decreases = 64 No Change = 538 Increases = 82
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Middle R. at Woodward Island
Changes which meet screening criteria
Desalination Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922					-8							
1923												
1924								6			-7	-9
1925	-7											
1926											-6	-14
1927	-11							-6	-7			
1928						-11						
1929							12	14	10			12
1930	29	34	28		-12		6	8			-6	-11
1931	-10			7	12	11	12	10				-9
1932	-8				-10					-6	-10	-16
1933	-25	-28	-12		10	9	7					-9
1934	-11		9	6							-6	-7
1935	-9		13	8	8						-10	-12
1936	-15	-10			-10							
1937					-8	-11						
1938	6		-7					6	6			
1939											-7	-18
1940	-15	-8			-8	-6						
1941					-10	-12	-7	-7				
1942	-12				-6			-13	-6			
1943	-10							-6				
1944	-12	-8		-6	-7		8	10				
1945												
1946												
1947												
1948						-6	-8					
1949			8	11	10						-8	-12
1950	-11	-6										
1951			-8									
1952				-8	-7							
1953				-6	-7				-6			
1954				6								-6
1955												-6
1956				-16	-17							
1957	-6											
1958					-9		6					
1959												-7
1960	-6	-6	-6	-6	-7			8				
1961							9	9				-7
1962								7				
1963												
1964	-6						6				-6	-13
1965	-16	-9			-6							
1966												-7
1967								-6				
1968												-8
1969	-7			-7	19							
1970				-15	-6							
1971					-10	-6						
1972	-6		6						-6			
1973					-9			-12	-15			-7
1974	-9					-7	-9	-16	-17			
1975	-8					-8	-9	-14	-20			
1976	-6											11
1977	25	28	23									
1978					12	26	37	9		6		

Decreases = 113 No Change = 522 Increases = 49
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Electrical Conductivity at Antioch
Changes which meet screening criteria
Middle River Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922		274	95				62			49		-415
1923	-375	845	109			-55						-608
1924	-843				276			-263				
1925		463		827	196			22	23	-114	-290	
1926			432	777	168		-48	-53		-384	-1165	-1481
1927	-951		604	463	21						-96	-976
1928	-753	512	731	396	75			28			-145	-871
1929	-324	622			575	606	1341	1614	964		381	1920
1930	2499	3001	2385	516	211	73	47			-610	-1419	-1569
1931	-952	-495	738	1488	1715	1617	1161	606	278			
1932			973	337	60	65	13			-526	-737	-1248
1933	-2383	-2302		1114	1484	962	196					
1934			911	1126	782	299	167			378		
1935			1709	560	27				32		-1075	-2346
1936	-1750	-538	610	358				42	43	56		-1034
1937	-852			-723	-81			91	115	74	257	629
1938	922	604	74									386
1939	437	262	690	949	617	333	218			-482	-1437	-1985
1940	-1314	-539		53						56	-98	-1061
1941	-873										-114	-825
1942	477	1986	216									-407
1943	845	1114	141								-130	-944
1944	-1343	-624	-407	-1222	-277	-68	-184	-82			280	692
1945	457	704	988	760	72		-45	132	101	125	348	464
1946	311	849	130			182	161	45	22	52	-118	-812
1947	-444	374		-427			-107	-74		-203	-591	-508
1948			837	860	1070	348	-80		40	65	-120	-539
1949		1280	1477	1666	1389	180		120	107	-572	-1579	-1930
1950	-1208	-451	736	910	125			169	116	66	414	333
1951		87						73	155	122	-84	-799
1952	-513	259	67									168
1953	177	79					22				-82	-596
1954		1591	1637	414	21				22		-173	-841
1955	-287	205	75	32			92	63			-515	-518
1956		1137	100								-107	-590
1957	-64	909	1759	583	44			75	83			-508
1958	192	587	274									
1959	187	573	1011	169							-347	-661
1960	-525	-1324	-1047	-524	-213	-91	-55					
1961				225	190	288	353	111		-312	-504	
1962				536	160		48					
1963	177	516	346	602	69						-100	-887
1964	-376	415	486	217			188	111		-600	-1481	-1961
1965	-1407	-445										-817
1966	-1463		370	100			64				-159	-1025
1967	-660									33	-55	75
1968	95	33	201	110							-335	-1074
1969	-429		-179								-116	199
1970	224	35									-246	-952
1971	-760	653	37							45		-671
1972	-381	1653	975	-93	-159	75	106				-284	-590
1973	-450	266	177					51	24		-339	-1035
1974	-750	199								40	-103	-151
1975	963	550	188	-642	-78					89	-109	-158
1976	240	122	118	341	744	214	606	1072	734	-475		1862
1977	2414	2915	1562	364	281							
1978				37		31	29				-191	-446

Decreases = 143 No Change = 308 Increases = 233
Differences with base near D1485: Increases = 8 Decreases or No Change = 2

Difference in Electrical Conductivity at Emmaton
Changes which meet screening criteria
Middle River Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922		153										-231
1923	-55	147									-48	-253
1924	-60	127	-78	129			243	236		181	-179	-474
1925		161		421							-110	
1926			317	160						-134	-548	-610
1927	-297		81	46								-391
1928		81	93	36							-27	-409
1929	217	192	-70	116	79	168	709	608	307	-166	517	1179
1930	1679	1428	826	74			21			-150	-443	-579
1931	-348	-80	443	521	628	531	463	278		122	-162	-363
1932		501	229	51						-225	-441	-928
1933	-1354	-749	305	407	538	184	141			-364		-407
1934		494	384	220	183	109	69		-107	-314	142	-322
1935		265	902	59							-348	-901
1936	-512	-272	366	40								-475
1937	-50	39		-230							110	352
1938	473	83										56
1939	49		104	274	163	101		69		-215	-757	-921
1940	-487	-136	107									-413
1941												-374
1942		277										-229
1943	47	118										-386
1944	-251	-143	-135	-285	-24				1		191	378
1945	163	172	196	190						22	108	117
1946	183	217					30				-30	-377
1947	123	123	-49	-143						-69	-267	-169
1948			578	179	446	41					-24	-228
1949	240	532	503	606	373			29		-196	-684	-775
1950	-420	-224	468	140							119	
1951												-293
1952	62	76										
1953												-240
1954		228	271	40							-30	-385
1955	183					23	21		4	-38	-297	-198
1956	269	446										-219
1957	-29	125	411	67								-200
1958	45	76	23									-58
1959	24	53	243						5		-175	-205
1960	-134	-602	-196	-136	-24		27					
1961			-49	132	24	58	118	30	2	-120	-190	
1962			-60	259	23		23					49
1963		48	22	69								-357
1964		41	106	22		60	70	25	9	-213	-571	-767
1965	-460	-102										-372
1966	-134		44								-72	-460
1967	114	-72									-30	
1968			22								-153	-426
1969	76		-27								-36	27
1970	24										-72	-337
1971	-77	100										-271
1972	-77	270	102								-55	-208
1973	-106	36									-77	-332
1974	-152											-37
1975	128	47		-89							-34	-39
1976	22			140	215		177	338	202	-273	421	1079
1977	1461	1254	195		-99	104	104				300	
1978	-279										-39	-116

Decreases = 128 No Change = 392 Increases = 164
Differences with base near D1485: Increases = 7 Decreases or No Change = 7

Difference in Electrical Conductivity at Jersey Point
Changes which meet screening criteria
Middle River Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922			35									
1923	-131	208	27								61	
1924	-339	-220			134	91	-82	-176	-108	-146		
1925		211	94	147	63						-26	
1926				247	77					34	-155	-415
1927	-347		144	246								-93
1928	-319	103	166	92	30						29	-71
1929	-347				218	179	102	344	318	137	102	728
1930	1012	1233	816	-48		45				-44	-273	-423
1931	-341	-238	-72	283	393	440	320	176	111		117	
1932			398							80	-59	-375
1933	-976	-1000	-476	184	339	364	85			210	129	
1934	-276		236	415	300	117	57		100	278	76	
1935	-230		326	249	21					24	-26	-462
1936	-558	-166		148								-54
1937	-353	-103		-116	-22					22	57	210
1938	203	194	28									98
1939	76	24	126	236	201	117	122			102	-212	-593
1940	-459	-201		32								-90
1941	-384	-145										-104
1942	192	456	55									-63
1943	157	172	23									-89
1944	-422	-255	-83	-244	-74		-25				73	264
1945	207	280	342	228	24							116
1946		286	42			29	28				31	-69
1947	-333		73			21	-29	-23			-74	-147
1948				196	167	-175	-68				23	-50
1949	-160	110	269	370	378	64			25		-125	-479
1950	-419	-173		193	52							100
1951		25								26	24	-42
1952	-256											36
1953												-28
1954		423	409	277							28	-54
1955	-291		33			-32				45		-157
1956	-105	123	29									-62
1957		96	380	277	62							40
1958	95	169	67									
1959	30	71	217	85							44	-84
1960	-132	-74	-269	-99	-60	-28	-40			29		70
1961					143	55				69	-73	
1962					42							
1963	68	69	70	66								-52
1964	-229	75	77	132	31	-102	-114				-156	-459
1965	-436	-177										-77
1966	-484	-53	31	25							44	-75
1967	-368	-86										35
1968				44							69	-79
1969	-260											37
1970	28											-89
1971	-288	99										-51
1972	-52	307	213	48	-28	22	31			29		-69
1973	-93	54										-109
1974	-195	87										
1975	218	90	21	-56							33	
1976	55			49	140	123	179	322	323	91		650
1977	910	1212	947	306	190							
1978						36	30					-71

Decreases = 113 No Change = 387 Increases = 184
Differences with base near D1485: Increases = 2 Decreases or No Change = 7

Difference in Chlorides at Old River at Rock Slough
Changes which meet screening criteria
Middle River Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922									-8			
1923	-11	10										
1924	-21	-24			10	10						
1925		31	15	16	12							
1926				20	10						-7	-34
1927	-38	-8	8	25								-6
1928	-25		10	7		-7						
1929	-27				14	19	15	32	34	21	14	69
1930	119	145	116		-10						-17	-37
1931	-37	-23	-9	25	38	46	39	26	15	11	12	
1932			37		-7						-8	-30
1933	-97	-115	-58	12	33	38	17	7		16	20	
1934	-26		36	38	34	16	10	7	9	19	13	
1935	-18		35	36	10						-6	-32
1936	-59	-26		15								
1937	-26	-13		-9	-9	-9						18
1938	29	20			7			9	7			
1939				18	20	14	10	6		11	-9	-52
1940	-53	-25				-6						-7
1941	-27	-15	-6		-7	-22	-13					-7
1942		30	10		-6			-9				
1943		8			-6							-6
1944	-31	-27	-9	-17	-13		6				6	24
1945	30	25	29	22	7	6						8
1946	12	22	8									
1947	-24		6									-14
1948				17	18	-17	-16					
1949	-12	9	25	38	39	11					-7	-36
1950	-45	-22		16								6
1951			-18	-6								
1952	-17				-7				-10			
1953												
1954		31	32	35								
1955	-22											-14
1956	-7	12		-18	-29			-8				
1957	-8		26	30	8							
1958	7	13	6			8	18		-7			
1959			14	9								-6
1960	-12	-7	-20	-10	-8							6
1961	6		6		18	9	6					-6
1962												
1963			6		7							
1964	-18			13			-8				-9	-34
1965	-45	-22										
1966	-32	-13										
1967	-28	-11						-14				
1968												
1969	-21			-6	17		-8		10			
1970				-7								
1971	-21											
1972	-7	16	21	6								
1973	-10				-7			-6	-9			-7
1974	-18							-8	-8			
1975	9	7				-7		-7	-11			
1976					12	13	16	27	30	19	9	59
1977	103	132	120	44	22	17	12	11	9	11		
1978					16	48	83	15				

Decreases = 114 No Change = 427 Increases = 143
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Rock Slough @ Contra Costa Canal
Changes which meet screening criteria
Middle River Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922		-10	28	33	97	142	17		-8			
1923	-17	10	23	109	158	35	-10					
1924	-17	-33	-8	12	21	16						6
1925		58	70	87	133	206	44					
1926			9	30	68	142	15				-6	-32
1927	-43	15	34	20	36	180	41		-7			-6
1928	-29		24	30	80	32	40					
1929	-28	-17		16	44	34	19	32	33	22	13	57
1930	114	141	145	125	152	131	43	6			-15	-35
1931	-39	-25	-12	21	56	48	42	30	15	10	12	8
1932		18	109	189	190	155	13				-7	-26
1933	-90	-102	-61	20	84	54	34	9		14	21	3
1934	-25	14	70	117	122	106	14	9	8	17	13	2
1935		27	78	84	204	92	122	13			-6	-27
1936	-64	-39	-9	52	37	225	35					
1937	-28	-22	-11	19	44	151	146					12
1938	24	65	39	28		201	120	16	6			
1939	11						19	11		10		-47
1940	-53	-27		30	119	249	125					-7
1941	-27	-25	7	10	117	182	111	8				-6
1942		27	20	16	147	132	46					
1943		12	12	28	156	85	68					
1944	-32	-41	-13	10	9	98	15	7				20
1945	28	49	60	61	74	155	73					7
1946		24	58	62	57	17						
1947	-26	-20		18	33	33	9					-15
1948	-11	14	8	31	39	10	6					
1949	-17		12	46	63	67	43				-7	-31
1950	-46	-30	-8	51	109	73	10					
1951		27	-13	57	148	84	14					
1952	-19	-18	28	-21	170	80	73					
1953				26	106	17						
1954	-11	30	39	29	31	10						
1955	-23	-16	24	25	131	27						-14
1956	-9	6	46	70	157	72		-6				
1957		11	13	8	12	22	6					
1958	13	23	11	18		189	184	23				
1959	8	9	8	16	9	62						
1960	-6	-17	-18	7	38	84	13	6				
1961	7		14	27	82	56	20	7				-8
1962			10	29	-27	172	28					
1963	21	16		9	113	128	100	10				
1964	-23	11	19	6	65	7					-7	-30
1965	-47	-27	42	62	150	38						
1966	-32	-11	11	27	107	46						
1967	-24	-25	30	-46	172	80	38	-9				
1968				7	33	24	10					
1969	-22	-12	24	-55	80	171	10	6				
1970					179	92	13					
1971	-24		33	120	98	14						
1972		13	22	30	22							
1973	-13	12	41	-68	107	232	69		-8			-7
1974	-24	12	22	49	118	36	22		-7			
1975	12	18		9	-7	64	68		-11			
1976	11	6			-14		18	28	28	20	8	51
1977	98	120	139	112	60	26	24	21	10	11		-21
1978		14	52	52	217	204	162	34				

Decreases = 94 No Change = 275 Increases = 315
Differences with base near D1485: Increases = 10 Decreases or No Change = 8

Difference in Chlorides at Old River at Highway 4
Changes which meet screening criteria
Middle River Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922					-7							
1923	-6											
1924	-8	-13					7					17
1925		19	11	7	7							
1926				12								-18
1927	-19	-7		12					-6			
1928	-14					-10						
1929	-14				6	10	13	21	21	11		29
1930	56	84	67	6	-13		6	7			-8	-20
1931	-19	-9	-7	11	21	26	24	20	11		11	17
1932		11	21		-9							-10
1933	-38	-57	-38		18	23	14	6		12	16	16
1934			20	20	18	9	9	7		14	6	13
1935			18	21	10						-7	-17
1936	-30	-17		7	-8							
1937	-15	-8			-9	-11						8
1938	15	12										
1939				8	10	9	6			9		-27
1940	-28	-14			-8	-8		-6				
1941	-14	-9			-9			-7				
1942	-8	13	6		-6			-11	-7			
1943	-8				-6			-6				
1944	-18	-16		-9	-10		8	8				12
1945	19	12	14	11		6	7					6
1946		10										
1947	-13											-7
1948				9	8	-8	-13					
1949	-8		12	19	22	8						-18
1950	-23	-12		8								
1951			-12	-8								
1952	-10			-8	-9				-6	-6		
1953				-7	-6							
1954		14	16	20								
1955	-12											-7
1956				-12	-19			-6				
1957	-7		12	15								
1958		6			-8	6						
1959			6									
1960	-6		-11	-7	-7			7				
1961					10	7	9	8				
1962												
1963					6							
1964	-11			7								-17
1965	-25	-14		-6	-6							
1966	-13	-8										
1967	-13	-6						-8				
1968												
1969	-12			-8	26				15		-6	
1970				-14	-8							
1971	-12				-7							
1972	-6	7	14									
1973	-6				-10			-8	-15			-6
1974	-11						-7	-13	-15			
1975						-9	-9	-12	-18			
1976					7	7		12	13	8		28
1977	53	72	65	25	9	6	10	11	7	8		13
1978	30				16	20		13		6		

Decreases = 112 No Change = 452 Increases = 120
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Clifton Court
Changes which meet screening criteria
Middle River Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922				-6			-7					
1923												
1924							9	10				
1925		13	8	10								
1926			7	7				9			-7	-16
1927	-14			6					-7			-7
1928						-15						-8
1929						10	22	22	16	9	11	23
1930	44	57	54		-12		10	11			-8	-15
1931	-14	-7		15	21	21	23	18				
1932			11		-11			9	6	-11	-22	-23
1933	-29	-43	-19	8	19	16	11	6				
1934			19	12	12	8	8	6				
1935			21	13	13			6		-6	-12	-16
1936	-23	-14										-8
1937	-6			-6	-6							6
1938	15	7										
1939				7	7	7		6			-6	-22
1940	-20	-11			-8							-7
1941												-6
1942	-14	6						-14				
1943									-6			-6
1944	-14	-12	-6	-8	-9		15	11	6			8
1945	12	6	7	8		7	9					
1946												
1947								8				-6
1948			6	7	10	-6	-10					
1949		10	15	21	19		6	7			-8	-14
1950	-16	-9										
1951												
1952									6	-7		
1953				-8	-8				-7			
1954		8	11	13								-7
1955												-7
1956		9										
1957			11	7					-8			
1958					-6							
1959			7					8				-7
1960		-8	-8	-7	-8		9	11				
1961					7	7	14	14				-6
1962							8	10				
1963					7							-7
1964								7			-7	-17
1965	-20	-10			-8				-6			-6
1966		-7			-6			6				-7
1967			-6	-6								
1968								7				-8
1969	-6			-9	13				6		-6	
1970												
1971					-10	-7						
1972	-6		10	6					-8			
1973	-6							-16	-20		-6	-10
1974	-10	-6				-7	-10	-19	-20			
1975	-10			9		-12	-12	-20	-23			
1976	-6			6	7			6		6	7	21
1977	43	50	47	17		16	18	14	8		9	12
1978	22				11	-12	-8	8		8		

Decreases = 107 No Change = 459 Increases = 118
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Tracy Pumping Plant
Changes which meet screening criteria
Middle River Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922							-9					
1923												
1924						6		7				10
1925	9	13	7	9								
1926				6				10				-10
1927	-10											
1928												
1929						7	14	14	10	15	15	24
1930	35	45	49		-9		6	12				-11
1931	-11	-7		16	19	18	16	11				11
1932			8		-7					-9	-24	-25
1933	-24	-35	-13	8	16	10						10
1934			19	9	9	6					7	11
1935	9		18	8	11						-9	-10
1936	-18	-9										-8
1937												
1938	11				6							
1939				6								-13
1940	-14	-9							6			
1941											-6	
1942							6					
1943	8											
1944		-7		-8	-7				7			7
1945	11	6		7		8	8					
1946	10	7			6							
1947								7				
1948				10	9	-6	-12					
1949		10	16	20	18							-10
1950	-13	-7										
1951			12			7						
1952									6			
1953												
1954			9	7								
1955												
1956		9						8				
1957			11						-7			
1958												
1959								8				
1960		-8	-6	-7	-7			8				
1961				8		8	9	13	-6			
1962				8				6				
1963					7	7						
1964			6					9				-9
1965	-13	-7			-6							
1966												
1967								7				
1968												
1969	-6					7				8		
1970												
1971					-7					6		
1972	-6											
1973				-10				-9	-12			
1974									-14			
1975				8		-6		-9	-10			
1976							12	9		15	13	21
1977	38	41	45	19		15	21	20	12		14	26
1978	27	11	8			-12		7				

Decreases = 52 No Change = 523 Increases = 109
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Electrical Conductivity at San Andreas Landing
Changes which meet screening criteria
Middle River Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922												
1923		27										
1924	-47	-41						-22		-23		-46
1925		59	26	44								
1926				41							-24	-86
1927	-89			56								
1928	-47											
1929	-47				29	32	30	59	63	26	45	198
1930	307	356	229	-42							-43	-84
1931	-74	-47		53	77	89	73	39	21			
1932	-60		82									-113
1933	-269	-253	-93	33	71	63	23			36		-48
1934	-94		72	75	57	27				38		
1935	-73		97	68								-79
1936	-119	-46		35								
1937	-49	-26		-24								38
1938	53	36										
1939				36	36	24					-39	-127
1940	-116	-48										
1941	-55	-35										
1942		60										
1943												
1944	-65	-49		-38								56
1945	49	54	59	42								
1946		50										
1947	-44											-35
1948				33	40	-70	-35					
1949		21	54	77	69						-23	-86
1950	-94	-44		31								
1951												
1952	-33											
1953												
1954		62	59	65								
1955	-37											-30
1956		27										
1957			51	48								
1958		24										
1959			27									
1960	-23	-29	-38	-21								
1961					39							
1962												
1963												
1964	-31			27							-23	-82
1965	-101	-44										
1966	-71											
1967	-54	-27										
1968												
1969	-35											
1970												
1971	-42											
1972		37	27									
1973	-21											
1974	-35	21										
1975	23											
1976					23		32	53	58	22	32	157
1977	241	303	222	72	39							
1978						36	21					

Decreases = 65 No Change = 534 Increases = 85
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Difference in Chlorides at Middle R. at Woodward Island
Changes which meet screening criteria
Middle River Future Project vs. Existing Conditions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1922					-7							
1923												
1924								6				-7
1925		6										
1926											-6	-13
1927	-11							-6	-6			
1928						-11						
1929							12	14	10			14
1930	32	36	30		-12		6	8			-6	-11
1931	-10			8	12	11	12	10				-7
1932					-10					-6	-10	-15
1933	-24	-27	-11		10	9	7					-7
1934	-8		10	6								
1935	-6		13	9	8						-10	-12
1936	-15	-9			-8							
1937					-7	-10						
1938	8		-7					6	6			
1939											-7	-17
1940	-15	-7			-7	-6						
1941					-9	-11	-7	-7				
1942	-12				-6			-13	-6			
1943	-11							-6				
1944	-12	-8		-6	-6		8	9				
1945	6											
1946												
1947												
1948						-6	-8					
1949			9	11	10						-7	-12
1950	-10	-6										
1951			-8									
1952				-7	-7							
1953				-6	-7				-6			
1954				6								-6
1955												
1956				-14	-16							
1957	-6											
1958					-7		6					
1959												-7
1960	-6	-6	-6	-6	-6			8				
1961							9	9				-7
1962								7				
1963												
1964	-6						6				-6	-12
1965	-16	-8			-6							
1966												-6
1967												
1968												-8
1969	-6			-6	12							
1970				-14	-6							
1971					-10	-6						
1972	-6		6						-6			
1973					-8			-12	-15			-8
1974	-9					-7	-9	-16	-17			
1975	-8					-8	-9	-15	-20			
1976	-6											12
1977	27	29	23	6			6					
1978					12	22	36	9		6		

Decreases = 106 No Change = 525 Increases = 53
Differences with base near D1485: Increases = 0 Decreases or No Change = 0

Section B-6. Detailed Fisheries Life Histories

CHINOOK SALMON

Chinook salmon are anadromous (i.e., they spend most of their life in the ocean and migrate up rivers to reproduce) and represent the most popular fish caught by commercial and sport anglers in California. Peak commercial catches in California occurred from 1940 to 1960 and the present catch averages about 400,000 fish per year. The annual ocean sport catch is approximately 100,000 fish and in-river sport catch is about 10,000 fish each year. Chinook salmon originating from the Sacramento and San Joaquin River systems provide 65% of the total California chinook salmon harvest (U.S. Fish and Wildlife Service 1987). Ocean salmon harvest removes 50-80% of the adult chinook salmon population (Pacific Fishery Management Council 1989).

Four runs of chinook salmon (fall, late fall, winter, and spring) occur in the Sacramento River and the fall-run occurs in the San Joaquin River. The fall-run chinook is the most abundant race, comprising about 80% of the Sacramento basin stock (Kjelson et al. 1982). Over 90% of the Central Valley salmon population spawns in the Sacramento River system and about 10% spawns in the San Joaquin River system.

River-spawned chinook salmon populations have declined in abundance from historical levels. Fall-run populations have been augmented by hatchery production, and escapement (i.e., adults returning to spawn in fresh water) has stabilized (Figure 1). Depending on the destination of the run, escapement of river-spawned fish is 10-50% of pre-1960 levels (U.S. Fish and Wildlife Service 1987). In contrast, late-fall- and winter-run populations are comprised primarily of river-spawned fish, and historical escapement continues to decline. Spring-run escapement has fluctuated dramatically (Figure 1) and spring-run chinook salmon that spawn in the Sacramento River may no longer be distinct from the fall-run stock (Reynolds et al. 1990).

Environmental conditions in the Sacramento-San Joaquin Delta (Delta) and rivers influence chinook salmon abundance. The relationship between population abundance and environmental conditions is discussed separately for the Delta and riverine habitats.

Delta

The Delta and Bay serve as a migration path for adult chinook salmon returning to their natal rivers to spawn. Different runs of adult chinook salmon move through the Delta every month (California Department of Water Resources and California Department of Fish

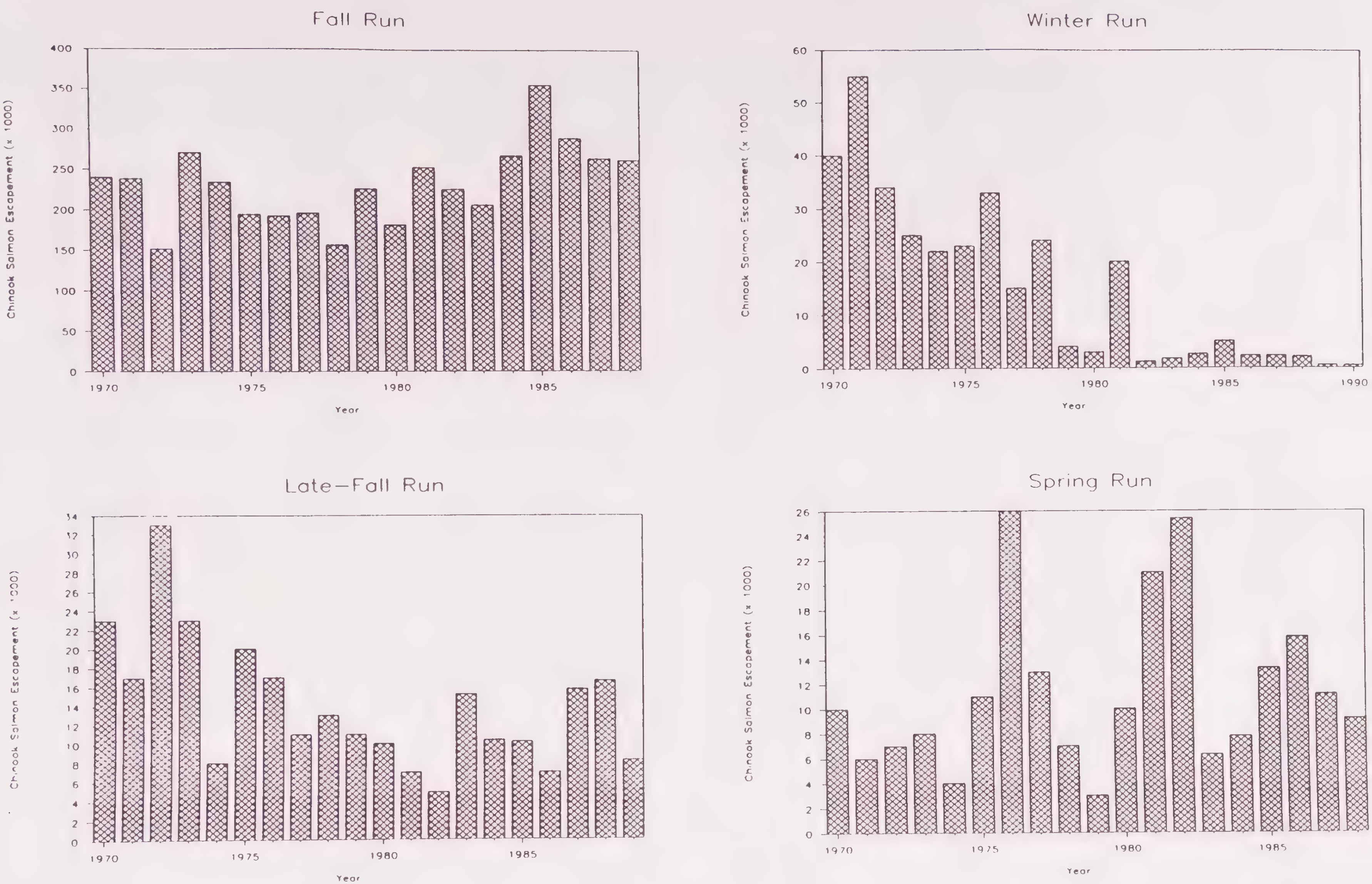


Figure 1. Escapement of Fall–, Late Fall–, Winter–, and Spring–Run Chinook Salmon in the Sacramento and San Joaquin Rivers

Source: Pacific Fishery Management Council 1989

and Game 1982). Timing of adult migration is an inherent characteristic of each run, modified by response to river temperature and flow (Figure 2). Migration of fall, late-fall, and winter runs may be stimulated by decreasing temperature and increasing flow in the lower river. The spring race may be stimulated to migrate upstream to avoid increasing spring water temperatures. Temperatures exceeding 65°F in the migration path have been shown to delay fall-run chinook salmon from migrating upstream in the Delta (Hallock et al. 1970).

The Water Quality Control Plan for Salinity in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (State Water Resources Control Board 1991) sets temperature objectives for chinook salmon at no greater than 68°F during April-June and September-November at Freeport on the Sacramento River and at Vernalis on the San Joaquin River. For winter-run chinook salmon, an objective of 66°F was set for January-March at Freeport on the Sacramento River. All temperature objectives are to be achieved by controllable factors other than reservoir releases. Temperature in the Delta is primarily dependent on meteorologic and hydrologic conditions. Although water project operations could be modified to affect Delta water temperatures, the change in temperature during most years would be relatively small and upstream storage would be reduced. Reduced storage would increase upstream water temperatures during summer and fall, adversely affecting the survival of eggs and juveniles.

Migrating juvenile chinook salmon, both smolt and fry, are found in the Delta and San Francisco Bay (Bay) throughout the year and migrate through the Delta primarily from October through June (Figure 3). Smolt are juveniles that have undergone physiological changes that enable them to survive in salt water. Smolt generally migrate through the Delta in less than a week. Fry are juveniles that have not yet become smolt and may rear in the Delta for more than a month before maturing into smolt.

Timing of migration through the Delta is partially dependent on race. Fall-run progeny migrate as fry (averaging about 40 millimeters [mm] in length) from January through March, as subyearling smolt (averaging 75-90 mm in length) from April through June, and as yearling smolt (averaging 95-160 mm in length) from about November through December. Late-fall-run subyearling smolt (averaging 75-90 mm in length) migrate in the fall about the same time as fall-run yearling smolt, while spring- and winter-run smolt (averaging 95-160 mm in length) migrate from January through May (Schaffter 1980, U.S. Fish and Wildlife Service 1987).

Smolt may depend on the Delta and Bay as transient rearing habitat during emigration through the system to the ocean. The estuary provides an abundant food supply and shallow low-velocity habitat. Salmon fry may rear in the Delta for several months, feeding in marshes, tidal flats, and sloughs. The fry leave the Delta and Bay environment when they grow to a threshold size of 70-100 mm (Cannon 1982, Kjelson et al. 1982) or when water temperatures exceed about 64°F. Water temperatures exceeding 64°F often occur in the upper estuary by May or June, and earlier in parts of the Delta (Cannon 1982).

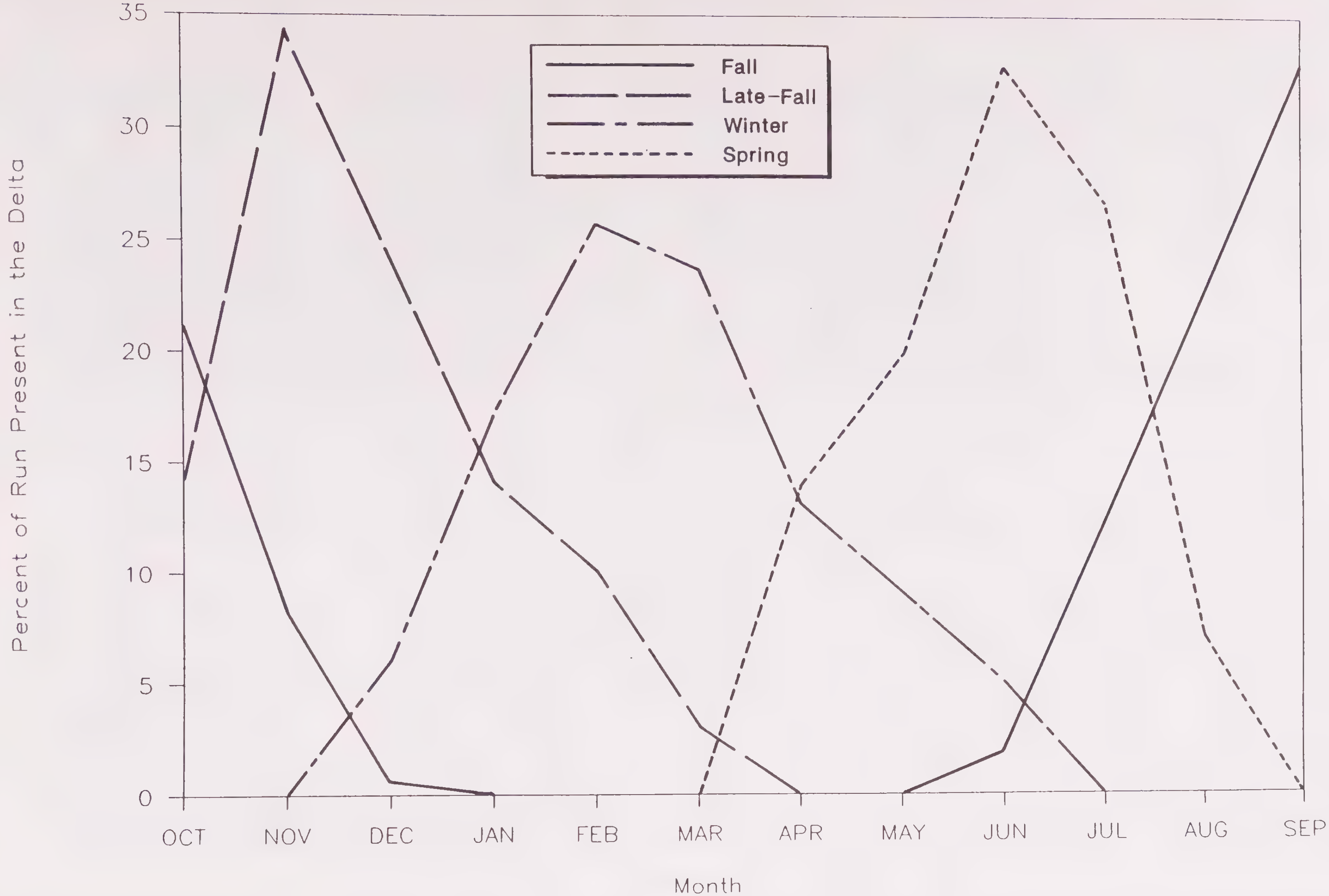


Figure 2. Timing of Adult Chinook Salmon Migration through the Sacramento-San Joaquin Delta

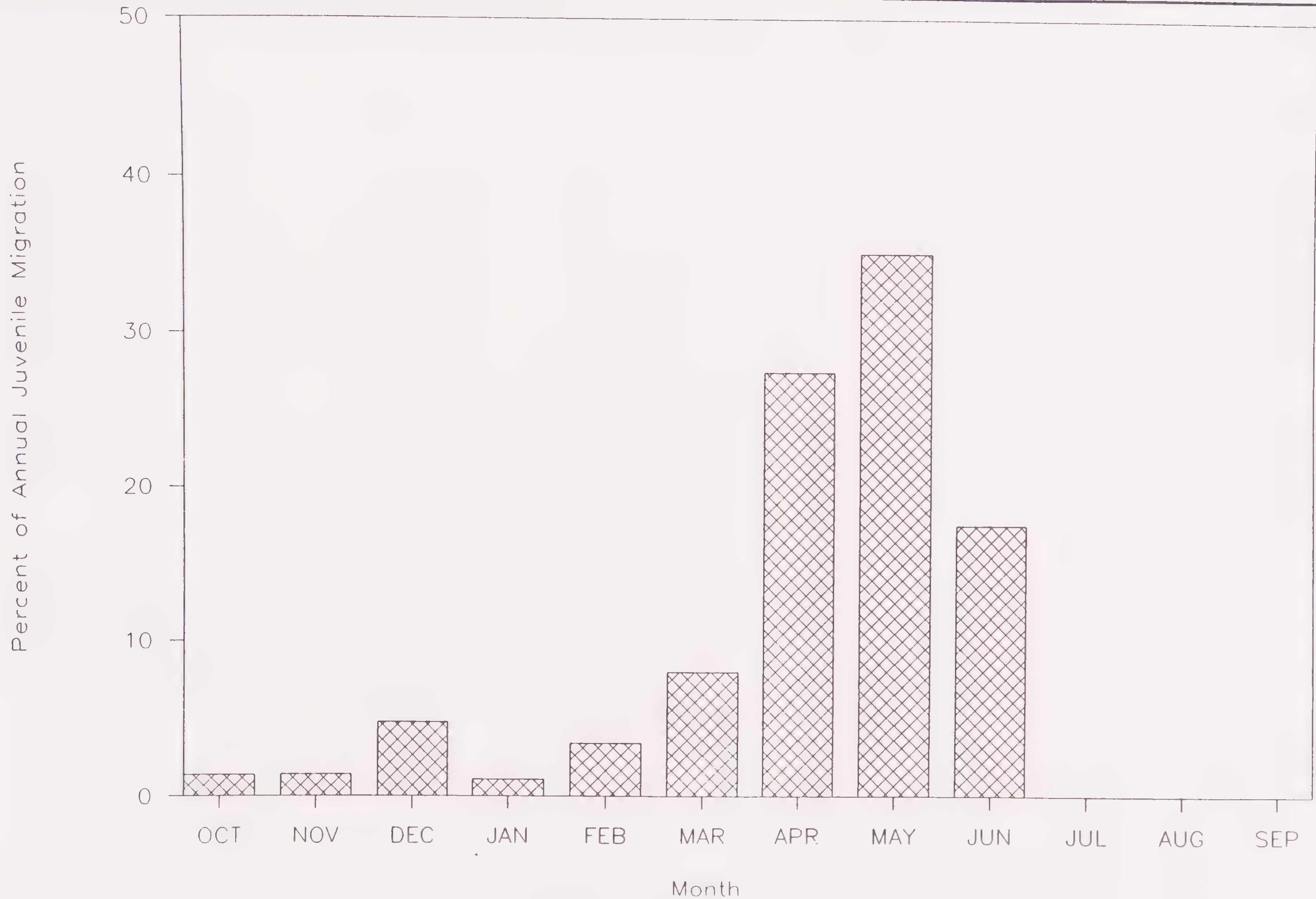


Figure 3. Timing of Juvenile Chinook Salmon Migration through the Sacramento–San Joaquin Delta

Source: State Water Project and Federal Water Project fish salvage data, 1981–1988

The proportion of a given run migrating seaward through the Delta varies annually. Peak migration of smolt through the Delta for fall-run chinook salmon originating from the San Joaquin River averages about 1 month earlier in spring than migration of Sacramento River fall-run fish (California Department of Fish and Game 1987a). Smolt spend variable periods in the Delta and Bay but generally emigrate 5-15 miles per day, approaching the higher rate as the season progresses (Wickwire and Stevens 1971).

The abundance of fry in the estuary appears to depend on riverflow, with high flow during wet years transporting greater numbers of fry downstream (U.S. Fish and Wildlife Service 1987). Because rearing occurs primarily in fresh water, higher riverflow also extends the rearing habitat farther down the estuary.

Environmental conditions in the Delta affect survival of adult and juvenile chinook salmon. Conditions affected by the State Water Project (SWP) and the Central Valley Project (CVP) operations include inflow volume, diversion via the Delta Cross Channel, lower San Joaquin River net flow, and volume diverted from the Delta. Specific environmental conditions that potentially affect the survival and growth of juvenile chinook salmon include temperature, predation, food production (and availability), and pollutant concentration (Herrgesell et al. 1983, California Department of Fish and Game 1987a).

Inflow

Stevens and Miller (1983) have found that juvenile chinook salmon abundance during April to June has been found to be positively correlated with Delta inflow during December. The cause of increased abundance is unknown; however, higher flow may increase quantity and quality of nursery habitat in rivers and reduce density-dependent mortality by dispersing young fish. Upstream factors may also play a role. December flows most likely affect the upstream habitat conditions for fall-run chinook salmon.

Trends in adult returns (fall run) before 1968 were related to the effects of flow (Dettman et al. 1986). Since 1968, however, no relationship exists between flow and adult return because hatchery releases downstream of the Delta stabilized the abundance of adult salmon and maintained adult returns. Survival rates of juvenile salmon released downstream of the Delta are not affected by riverflow and Delta environmental conditions.

Delta Cross Channel

The number of juveniles entering the central Delta are assumed to be in direct relation to the proportion of Sacramento River water flowing into the central Delta via the Delta Cross Channel and Georgiana Slough (Schaffter 1980, U.S. Fish and Wildlife Service 1987). Flow in the Delta Cross Channel and Georgiana Slough is determined primarily by Sacramento Riverflow and operation of the Delta Cross Channel gates (Figure 4).

Studies by the U.S. Fish and Wildlife Service (1987) showed that survival of hatchery-reared fall-run chinook salmon released in the Sacramento River upstream of the Delta

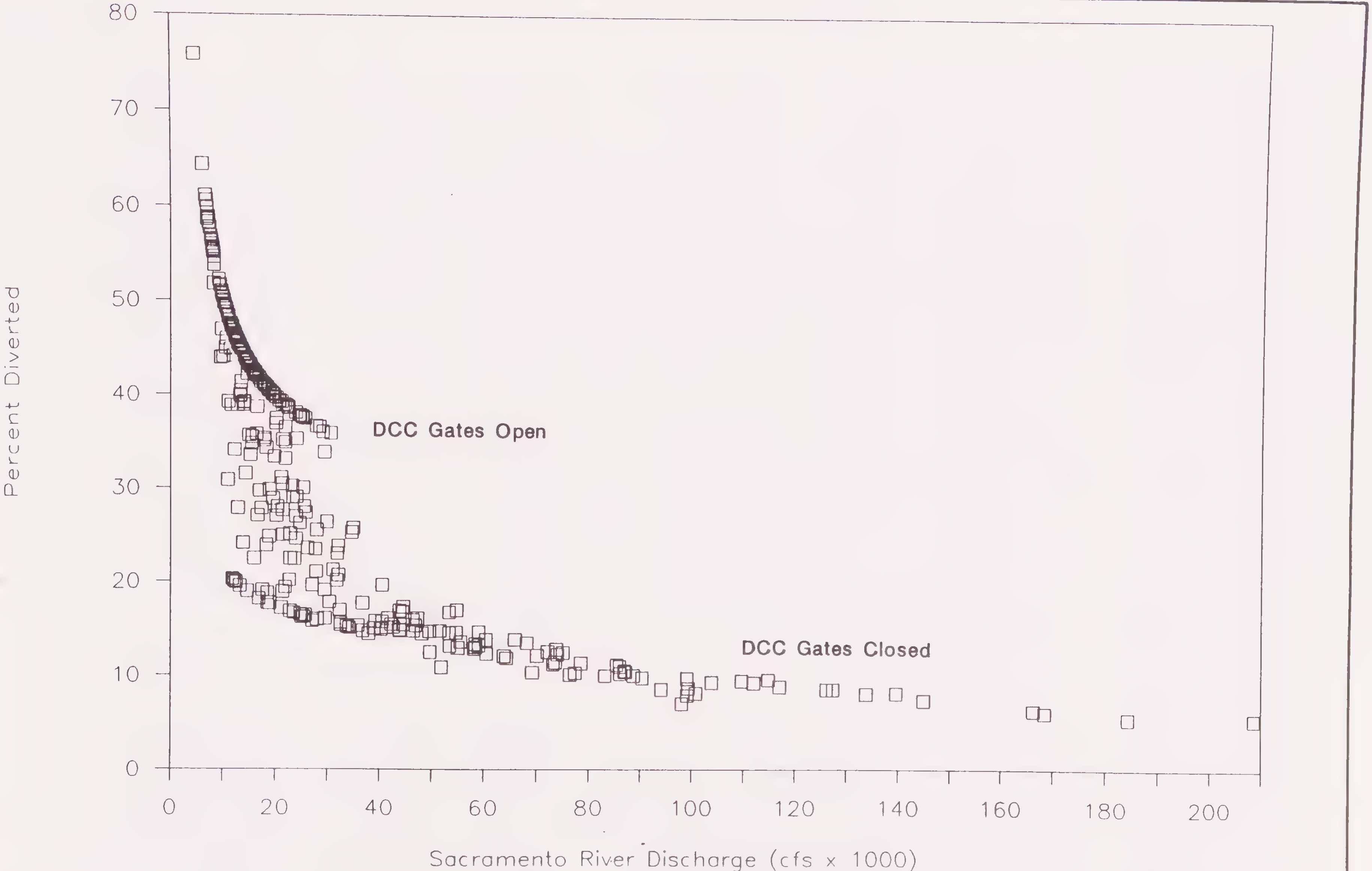


Figure 4. Percent of Sacramento River Discharge Diverted into the Delta Cross Channel and Georgiana Slough at Various Sacramento River Discharge Volumes

Source: California Department of Water Resources 1989

Cross Channel is lower than the survival of the hatchery-reared fall-run chinook released in the Sacramento River downstream of the Delta Cross Channel when the channel gates are open. A proportion of the fish released upstream of the Delta Cross Channel are drawn into the central Delta. Movement through the central Delta exposes smolt to increased predation, higher temperatures, and more agricultural diversions. Complex channel configurations and the absence of seaward flow in the central Delta confuse the smolt and delay or prevent passage to the ocean.

When the proportion of Sacramento River discharge drawn into the central Delta is high (greater than 60%) and the Delta Cross Channel gates are open, survival of smolts released above the Delta Cross Channel has been about 50% lower than for those released below the Delta Cross Channel (U.S. Fish and Wildlife Service 1987). When Delta Cross Channel gates are closed, only Georgiana Slough carries water to the central Delta and survival of salmon is similar for the two release locations.

During spring 1989, chinook salmon smolt survival was estimated during relatively constant riverflow (about 10,000 cfs in May and 13,000-14,000 cfs in June) at variable temperatures (60-62°F in May and 67-73°F in June) and fish release locations (Kjelson et al. 1990). Survival of smolts released above the Delta Cross Channel (gates open) was lower than survival of smolts released below Georgiana Slough; survival of smolts released below Georgiana Slough was lower than survival of smolts released in Steamboat and Sutter Sloughs. A proportion of the smolts released above the Delta Cross Channel enter the central Delta where the migration route is longer and survival is reduced. Smolts released below Georgiana Slough may be carried upstream by tidal currents and enter the central Delta via the Delta Cross Channel or Georgiana Slough, accounting for reduced survival rates relative to survival rates for smolts released in Steamboat and Sutter Sloughs.

Temperature is a primary factor influencing the survival of chinook salmon in the Delta, especially during May and June (Kjelson et al. 1989a). Water temperatures above about 60°F reduce survival rates for salmon migrating through the Delta, regardless of migration route. At Sacramento River temperatures less than about 67-69°F, chinook salmon juveniles diverted through the Delta Cross Channel have a much lower chance of surviving than juveniles that continue down the Sacramento River (Kjelson et al. 1989a). At Sacramento River temperatures above about 67-69°F, both juveniles remaining in the river and those diverted through the Delta Cross Channel have lower probabilities of survival.

Agricultural diversions are also believed to contribute to the difference in survival between chinook salmon entering the central Delta and those continuing down the Sacramento River (U.S. Fish and Wildlife Service 1987). Juvenile chinook salmon drawn into the central Delta are exposed to more agricultural diversions for a longer time than juveniles continuing down the Sacramento River. Delta withdrawals by agricultural diversions are highest during late spring and summer (California Department of Water Resources 1989a).

Juvenile chinook salmon drawn into the central Delta are potentially subjected to increased predation. Abundance of Sacramento squawfish and striped bass, major predators of juvenile chinook salmon, is highest in the Delta during late winter and early spring (Pickard et al. 1982). Although high predation has not been documented for smolt migrating through the central Delta, delay in migration is assumed to increase exposure of juvenile salmon to Delta predators.

Lower San Joaquin River

Migrating adult chinook salmon, having arrived in the Bay, follow the salinity gradient through the Bay to the western Delta (U.S. Fish and Wildlife Service 1987). Once in fresh water, adults are thought to use their olfactory sense to discriminate between the waters of their home stream and other streams. Sacramento River chinook salmon migrate primarily up the mainstem Sacramento River, although some fish use the tributaries of the Mokelumne River and enter the Sacramento River through Georgiana Slough or the Delta Cross Channel, following Sacramento Riverflow that moves through these channels.

The presence of Sacramento River water in the central and southern Delta, a result of Delta Cross Channel and Georgiana Slough diversions and high CVP and SWP export pumping, draws more Sacramento River chinook salmon along the Mokelumne River path and delays upstream migration of both Sacramento and San Joaquin River chinook salmon (Hallock et al. 1970). Delay of upstream migration in the Delta has not been shown to affect subsequent run size.

Reverse flows in the lower San Joaquin River have not been correlated with Sacramento River smolt survival. For smolt drawn into the central Delta via the Delta Cross Channel and Georgiana Slough, delay and exposure to predation probably increase when flow in the lower San Joaquin River is reversed and export by the CVP and SWP is high.

Hatchery-reared fall-run smolt released at several Delta locations experienced the lowest survival rates when released in Old River south of its junction with the San Joaquin River (U.S. Fish and Wildlife Service 1987, California Department of Fish and Game 1987a). The lower survival rate probably resulted from migration toward the SWP and CVP pumps rather than seaward. Mortality is higher because of elevated temperatures in the south Delta during late spring, increased predation in Clifton Court Forebay and at the SWP and CVP fish protection facilities, and entrainment in export.

Chinook salmon smolt migrate out of the San Joaquin River during March through May; migration generally peaks in April. San Joaquin juveniles are drawn toward the CVP and SWP pumps through Old River near Mossdale. Juvenile salmon moving down the mainstem San Joaquin appear to survive better than those diverted. Studies are under way to estimate survival for different migration routes (California Department of Fish and Game 1987a). The effects of reverse-flow conditions in the lower San Joaquin River described for smolt drawn into the central Delta from the Sacramento River would probably be the same for smolt from the San Joaquin River.

Chinook salmon smolt that avoid diversion out of the Sacramento River at the Delta Cross Channel and Georgiana Slough probably migrate to the ocean without delay. Tidal currents dominate Sacramento River hydrodynamics at the junction of Three Mile Slough and the lower San Joaquin River except during very high river discharge. Most juvenile salmon migrating out would likely move with the relatively larger tidal flow volume or follow the salinity gradient. Movement up the lower San Joaquin River and into the central Delta would not be expected; however, a proportion of the tagged chinook salmon released at Jersey Point on floodtide in 1989 moved through the central Delta and were recovered at the Harvey O. Banks pumping facility (Kjelson et al. 1990).

Diversions

Chinook salmon juveniles are entrained in diversions from the Delta, including diversions by local water users and water exporters. The number of salmon entrained annually by SWP and CVP export is estimated to exceed 500,000 fish and may exceed 2 million fish during some years (California Department of Fish and Game 1987b). As many as 425,000 salmon may be screened annually and returned alive to the Delta. Substantial numbers of salmon are also entrained in other diversions from the Delta, including over 1,800 agricultural diversions, the Contra Costa Canal, the City of Vallejo diversion, and western Delta industry diversions (California Department of Water Resources 1987b).

Although the Sacramento River system produces more than 80% of the fall-run chinook salmon, the majority of juveniles salvaged at the CVP and SWP export pumps during the spring are from the San Joaquin River (U.S. Fish and Wildlife Service 1987). San Joaquin River juveniles are pulled toward the pumps through Old River, Middle River, and other sloughs transporting water across the central Delta.

Substantial numbers of Sacramento River chinook salmon are also entrained in CVP and SWP export. Juveniles are drawn into the central Delta via the Delta Cross Channel and Georgiana Slough. Movement of water across the central Delta toward the export pumps disorients the juvenile salmon; the confused fish migrate south in Old and Middle Rivers and can be entrained in water exported from the Delta.

The salmon drawn into diversions are subjected to increased predation, especially in Clifton Court Forebay where predation mortality approaches 75% (California Department of Fish and Game 1987b). Increased predation is partially the result of high concentrations of predators (Kano 1990). Screening efficiency for chinook salmon smolt at the SWP pumps range from 65 to 78% (California Department of Fish and Game 1987b). The screens at the approach to the CVP pumps change in efficiency with the tides. Velocities of water through the CVP screens can vary from 0.5 foot per second (fps) to 5.4 fps, depending on the interaction of tides and export pumping rates (Shinmoto pers. comm.). The preferred velocity range is from 3.0 to 3.5 fps (California State Water Resources Control Board 1978a). Salmon salvaged are transported to Sherman Island where they are released into the Sacramento River. Additional mortality occurs during trucking, handling, and release.

Rivers

Change in Delta conditions has contributed to the decline in chinook salmon populations. Change in upstream conditions, however, is the primary factor responsible for decline in abundance of river-spawned fish relative to historical levels. Dams have blocked access to historical spawning and rearing areas and restricted spawning and rearing to habitat where environmental conditions are dependent on reservoir operations. The distribution and abundance of each run is limited by the availability of suitable habitat during chinook spawning seasons.

Sacramento River

Fall-run chinook salmon production in the Sacramento River system is dependent on two sources: hatcheries and natural production. Although different factors limit the production from each source, the major limiting factors for both are water temperature and diversions. Facility space is an additional factor limiting hatchery production, and habitat availability limits natural production. The available spawning and rearing habitat is controlled primarily by flow and temperature, although other factors (e.g., gravel recruitment and channelization) exert a major influence.

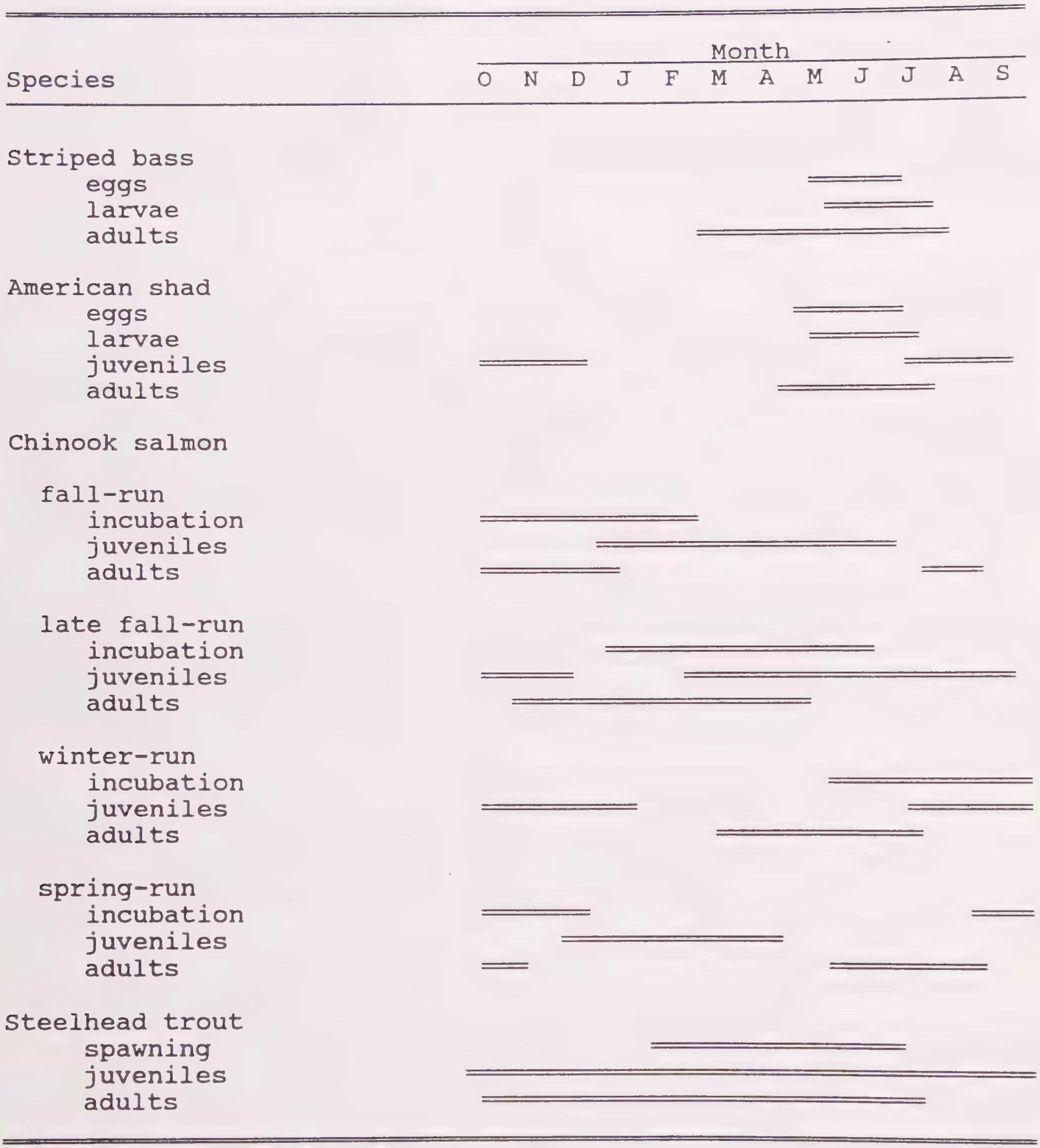
Temperature. Chinook salmon are coldwater species sensitive to temperature changes within and above optimum levels. In general, all chinook salmon species at all life stages prefer temperatures between 42 and 58°F (Reiser and Bjornn 1979). Temperatures of up to 68°F are tolerable for migrating juveniles and adults, although juvenile survival during migration through the Delta appears to decline at temperatures above 60°F (Kjelson et al. 1989a).

In the Sacramento River, fall-run spawning activity typically peaks in November but varies annually depending on water temperatures; higher water temperatures (greater than 60°F) are known to delay fall spawning. Late-fall-run chinook spawn from January through March, winter-run fish typically spawn from April to early August, and spring-run fish spawn from late August to early October (Table 1).

Egg incubation rates are dependent on water temperature. Eggs hatch into alevin (larval salmon) in 5-11 weeks, and the alevin remain in the gravel several more weeks until most of the egg yolk is absorbed. The expected monthly survival of eggs and alevins begins to decline substantially at water temperatures above 57.5°F. Healy (1979) reported egg mortalities of 80% at 61°F and 100% at 63°F for Sacramento River chinook salmon.

The survival of juveniles begins to decline substantially at temperatures above 66 or 67°F; however, growth rate may decline at temperatures exceeding 60°F, depending on food availability and other factors (Rich 1987). Reduced growth rates can be detrimental, possibly resulting in increased freshwater residence or smaller size at ocean entry, factors that may contribute to reduced survival.

Table 1. Approximate Peak Temporal Occurrence of Anadromous Species by Life Stage in the Sacramento River



Cool water released from Shasta and Clair Engle Reservoirs into the Sacramento River during warm periods can increase chinook salmon survival, especially for those salmon spawning during summer and fall (U.S. Fish and Wildlife Service 1987). In the section of river between Keswick Dam and Red Bluff Diversion Dam, ambient air temperature (the main factor) and flow volume determine the distance downstream that cool water released from Shasta and Clair Engle Reservoirs would travel. Below Red Bluff Diversion Dam, ambient air temperature and shade from riparian vegetation are the main factors that control water temperature.

Temperatures in the Sacramento River below Keswick Dam frequently exceed levels that adversely affect survival of eggs and juvenile salmon. Survival of winter-, spring-, and fall-run chinook salmon in the river have been reduced by elevated temperatures. Elevated river temperatures may result when Shasta Reservoir storage is low and reservoir temperatures are high. Low reservoir storage occurs primarily during drought conditions; however, increasing water demands on the CVP may increase the frequency and intensity of elevated river temperatures in the Keswick to Red Bluff Diversion Dam river section (Reynolds et al. 1990).

Flows. Chinook salmon require a minimum stream depth for upstream migration and spawning (Allen and Hassler 1986). Substrate requirements for spawning and incubation are fairly rigid; substrate must be composed of unconsolidated and silt-free materials of the appropriate size with adequate intragravel flow that occurs at the proper stream depth, current velocity (1-3 fps), and bottom contour. Salmon lay eggs in nests dug into the gravel. Adequate water velocities are required to assist the female in nest excavation and for maintaining intragravel flow.

The stream depth preference of juvenile chinook salmon is about 3 feet and may be influenced by water velocity, instream cover, fish size, and abundance of predators and competitors. Rearing fry prefer soft substrates, such as silt (possibly because soft substrates are associated with low water velocities), but fry are sometimes found in areas of gravel, cobble, or bedrock.

As juveniles grow, they will seek faster waters, usually locations adjacent to high velocities where prey is more abundant. During migration, smolt appear to favor the portion of the channel with the highest velocity (Schaffter 1980).

Juvenile salmon outmigration is a complex phenomenon that is not fully understood. Some fry migrate seaward immediately after emergence while others rear in the river several months before migrating downstream. Rearing and migration activities are not completely separable as they can occur concurrently. Temperature and flow are thought to exert a major influence on emigration rates of emergent fry, fingerlings, and presmolt. Salmon outmigration also has been correlated with periods of high turbidity (Reimers 1973, Davis 1981).

Based on available information, 6,000 cfs is believed to provide good to optimal spawning and rearing habitat area in the upper Sacramento River (U.S. Fish and Wildlife

Service 1987). A major study is nearing completion that will provide detailed information on chinook salmon habitat needs and availability in relation to flow rates (Hayes pers. comm.).

In addition to the effect of flows on habitat availability, fluctuations in flow may reduce abundance. Fluctuating flow can dewater nests, killing eggs and alevins and stranding juveniles. Although quantitative data are lacking, mortality attributable to stranding of juveniles may be substantial (U.S. Fish and Wildlife Service 1990).

Red Bluff Diversion Dam. The Red Bluff Diversion Dam is a barrier to upstream migration, preventing and delaying upstream passage of chinook salmon (Hallock and Fisher 1985, U.S. Fish and Wildlife Service 1988). Winter- and spring-run chinook salmon that do not migrate upstream past Red Bluff Diversion Dam do not spawn successfully during most years because of deleterious temperatures (Fisher pers. comm.). Salmon that are delayed may suffer reduced fecundity. Since December 1986, the Red Bluff Diversion Dam gates have been raised December 1 through about April 1 each year as part of Reclamation's winter-run chinook salmon protection efforts. The raised gates reduce the incidence of delay and blockage of chinook salmon adults, especially late-fall and winter runs.

Portions of the juvenile chinook salmon population migrating downstream past Red Bluff Diversion Dam are lost to diversion into the Tehama-Colusa and Corning Canals. Maximum annual loss of all chinook salmon to diversion at Red Bluff Diversion Dam is estimated at <1% of the total migrating population (U.S. Fish and Wildlife Service 1988). The diverted proportion can approach 20% of the Sacramento Riverflow during some years in September and 15% in October. Fish screens recently installed at Red Bluff Diversion Dam could substantially reduce diversion-related mortality.

Predation losses above Red Bluff Diversion Dam in Lake Red Bluff and immediately below the dam are high because juvenile fish are disoriented by the altered flow conditions and become easy prey for fishes and birds. Predation losses of chinook salmon have been estimated to range from 29 to 77% of the migrating population. Predation by squawfish, the primary predator of juvenile chinook salmon at Red Bluff Diversion Dam, is particularly evident during the spring upstream squawfish migration (U.S. Fish and Wildlife Service 1988). Predation losses may be a significant factor in the decline of Sacramento River salmon production.

Diversions. Diversions, including diversion at Red Bluff Diversion Dam, reduce chinook salmon survival. The primary diversions are for irrigation of agricultural lands, with about 60% of Sacramento River diversions occurring upstream of Ord Ferry (South of Hamilton City) (U.S. Bureau of Reclamation 1986). Chinook salmon juveniles rear and migrate through the section of river above Ord Ferry and are subject to entrainment in the diversions. Major diversion occurs from April through October and diversion during November through March is usually a negligible proportion of Sacramento Riverflow.

Iron Mountain Mine. Iron Mountain Mine is located in the foothills of the Trinity Mountains in the Spring Creek watershed, a tributary to the Sacramento River above Keswick Dam. Mining activities have exposed excavated material to rainwater, and

production of sulfuric acid occurs at this site. The acid leaches metals such as copper and zinc from the excavated material and the metals and acidic water discharge to the groundwater or adjacent creeks (National Oceanic and Atmospheric Administration 1989).

Until recently, discharge of toxic mine waste to Spring Creek was confined to high-precipitation events. Substantial chinook salmon mortality occurred when releases from Shasta Reservoir were insufficient to dilute mine discharge below toxic levels. Most fish mortality occurred during the wet season (i.e., late fall through early spring) because of increased mine runoff (National Oceanic and Atmospheric Administration 1989).

The mine is a U.S. Environmental Protection Agency Superfund cleanup site. EPA actions have reduced mine waste runoff by preventing the flow of water through the tailings, removing tailings, and treating waste to remove toxics. Ongoing remediation projects are aimed at further reducing waste volume and concentration of toxics.

If mine waste discharge is successfully reduced, Iron Mountain Mine waste may no longer cause declines in Sacramento River chinook salmon populations. Contaminated sediment from the mine, however, is stored behind Spring Creek Debris Dam and in the Spring Creek arm of Keswick Reservoir. The potential for accidental spills and the effect of CVP operations on sediment mobilization need to be considered in determining the need for additional remedial action.

Trinity River

The Trinity River supports a fall and spring run of chinook salmon. Lewiston Dam blocks access to an estimated 109 miles of anadromous fish habitat. The quantity and quality of habitat available to chinook salmon is dependent on the quantity and quality of water released from Lewiston Reservoir, inflow from tributary streams, and the physical condition of the river channel receiving the releases. Chinook salmon in the Trinity River have the same temperature and flow requirements described for Sacramento River chinook salmon.

The Trinity River Fish Hatchery was constructed to mitigate the production capacity lost from blockage and inundation of habitat upstream from Lewiston Dam and provides a major component of the existing Trinity River chinook salmon run. Juvenile anadromous fish released from the hatchery depend on the Trinity and Klamath Rivers for access to the ocean as well as for rearing. Adult fish must also ascend the river to return to the Trinity River Fish Hatchery.

Riverflows may directly affect the level of river-spawned fish production and the success of the hatchery in fulfilling its mitigation role. Ongoing instream flow studies in progress will provide useful information on habitat-discharge relationships for chinook salmon.

American River

The lower American River supports only fall-run chinook salmon. The current annual river spawning escapement of American River chinook salmon (including hatchery production) averages over 45,000 fish. Total annual American River production of adult salmon, including commercial and sport catch in the ocean, is nearly 250,000 fish. The majority of fish produced are the progeny of hatchery spawners. River-spawned fish comprise 20-40% of total production. (Dettman and Kelley 1987.)

Chinook salmon enter the American River between August and January (Gerstung 1971, Leidy and Li 1987). Spawning usually begins in October and ends by January (Gerstung 1971). Peak spawning occurs during November and early to mid-December and, except for fish returning to the hatchery, nearly all chinook salmon spawn in the 6.6 miles immediately below Nimbus Dam.

Temperature. Lower American River water temperatures often exceed levels optimal for egg survival (i.e., 57.5°F) through November, affecting both in-river and hatchery production. Spring rearing temperatures can become detrimental during May and June (Leidy and Li 1987). Hatchery production is not greatly affected by the spring temperature regime because water temperatures in the hatchery are cooler than downstream river temperatures and ample food is provided to meet metabolic needs at higher temperatures (Ducey pers. comm.).

Many chinook salmon fry migrate out of the lower American River immediately after they emerge from their nests in late winter and early spring (Gerstung 1971, Kelley et al. 1985). Remaining fry rear in the river and emigrate in April, May, and June. Juvenile chinook salmon that do not migrate by late June are likely to suffer high in-river mortality from deleterious summer water temperatures (Leidy and Li 1987).

Flows. Riverflows may directly affect the success of the hatchery in fulfilling production goals and the level of river-spawned fish production. Instream flow studies indicate that maximum spawning habitat is present at about 1,750 cfs and maximum rearing habitat is present at 300-1,000 cfs.

WINTER-RUN CHINOOK SALMON

Additional information is provided for the winter-run chinook salmon because the winter run is listed as a threatened species under the federal Endangered Species Act and as an endangered species under the state Endangered Species Act.

Historically, the winter-run chinook salmon population was probably smaller than spring and fall runs, and spawned primarily in the McCloud River. Shasta and Keswick Dams blocked access to the McCloud River but created favorable coldwater spawning and incubation conditions in a 44-mile reach of the Sacramento River downstream from Keswick Dam.

The estimated number of winter-run salmon has declined from a 3-year average (1967-1969) of 83,916 fish to less than 2,000 fish during the 1980s (Figure 1). Although efforts are being made by Reclamation to restore the winter-run population (i.e., Red Bluff Diversion Dam gates have been raised during December to April, and cool water has been released from Shasta Reservoir by bypassing hydroelectric generation), the population has continued to decline. In 1990 and 1991, the winter run was estimated to be less than 450 and 200 fish respectively (Smith pers. comm.). The continued decline may be attributable to drought conditions since 1987.

Delta

Although riverine factors are the main cause of winter-run decline, estuarine factors also affect survival rates. Several estuarine factors that may have contributed to the decline of the winter-run chinook salmon include changes in Delta environmental conditions caused by water diversions that draw Sacramento River water into the central Delta. Winter-run juveniles are carried along with the Sacramento River water into the central Delta and are delayed in their outmigration. Predation losses and losses to unscreened diversions also reduce winter run survival and increase when the young fish are delayed.

Juveniles in the central Delta may be drawn toward the CVP and SWP export pumps where further predation and entrainment mortality occurs. Juvenile winter-run chinook can occur in the Delta during October through May and appear to be most numerous in the Delta during February-April (Figure 5). Odenweller (1989) presented data indicating that possibly 75% of the winter-run chinook salmon salvaged at the SWP and CVP export pumps were entrained in March and April; an unknown proportion of these fish may be spring-run salmon from the Sacramento River or fall-run salmon from the Merced River.

Rivers

Red Bluff Diversion Dam is believed to be one of the causes of reduced winter-run chinook salmon abundance (U.S. Fish and Wildlife Service 1988, Fisher pers. comm.). Another cause of reduced winter-run abundance is deleterious temperatures in the Sacramento River above Red Bluff Diversion Dam during the spawning, incubation, and early rearing period (Table 1).

Other riverine causes of decline in winter-run abundance include reduced availability of spawning gravel, toxic discharge from Iron Mountain Mine, and diversion losses from the Sacramento River (Anderson-Cottonwood Irrigation District diversions, Glenn-Colusa Irrigation District diversions, and other agricultural diversions). Reduced habitat caused by fluctuating or inadequate riverflow and bank stabilization may also have contributed to the winter-run decline.

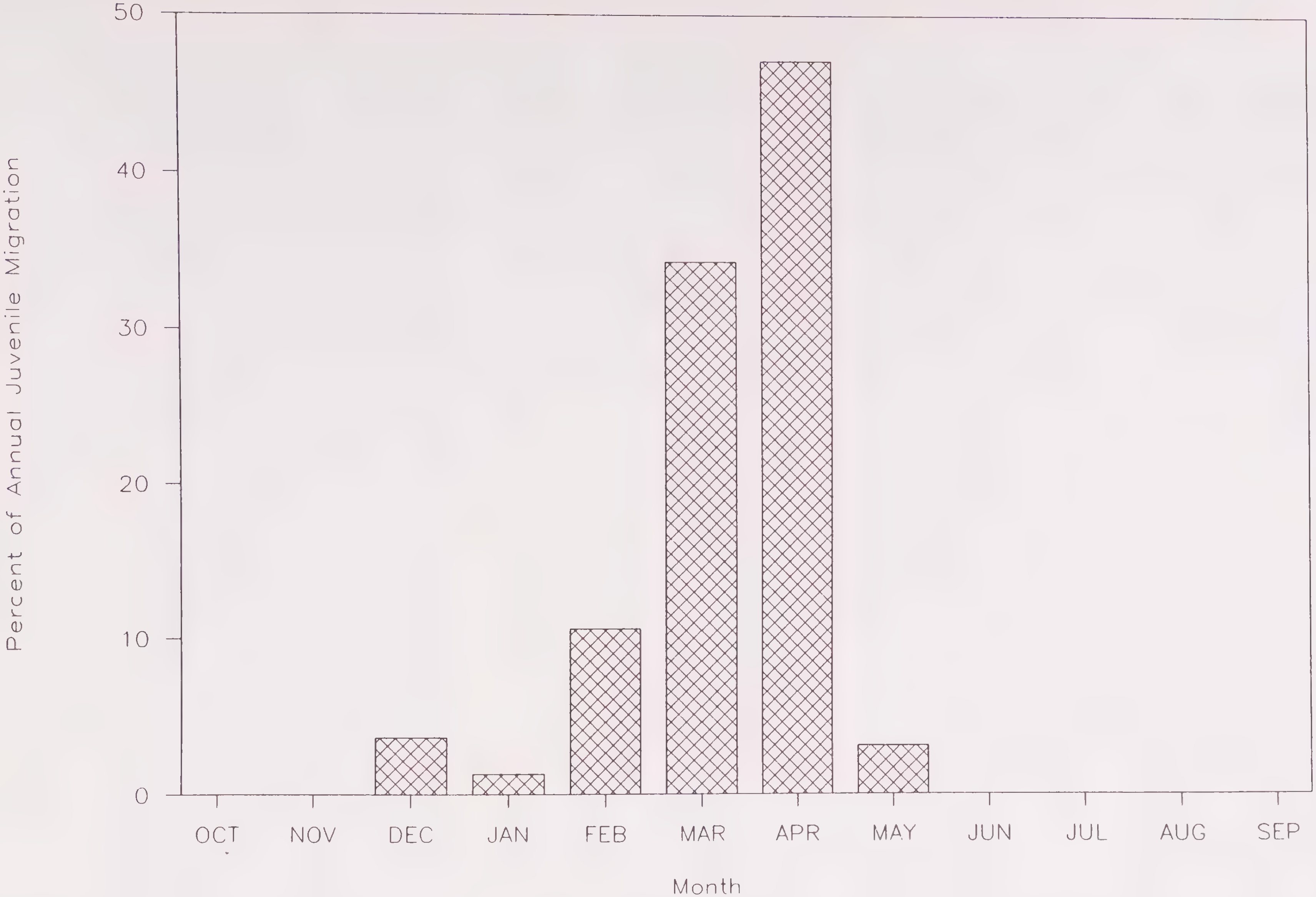


Figure 5. Timing of Juvenile Winter-Run Chinook Salmon Migration through the Sacramento-San Joaquin Delta

Source: State Water Project fish salvage data, 1981-1988; Separation of runs based on Stevens 1989

In-river sport fishing historically reduced the spawning population, but recent regulations prohibit capture of salmon when adult winter run are present in the river (California Department of Fish and Game 1989). Ocean commercial and sport fishing reduce adult escapement to the rivers by about 45% (California Department of Fish and Game 1989). Recent reductions in season length and closures in sport fishing areas may reduce total ocean commercial and sport catch of winter run chinook salmon.

STEELHEAD TROUT

Steelhead trout spend approximately equal proportions of their lives in fresh water and salt water. Steelhead comprise an important recreational fishery in the Sacramento River system and in the Trinity River. The historical range of steelhead trout in rivers controlled by the CVP has been reduced considerably by Folsom, Shasta, Lewiston, and other dams that restrict steelhead to the lower portions of the Sacramento, American, and Trinity Rivers.

The reduction in historical spawning and rearing habitats, in conjunction with overall habitat degradation from many causes, has led to a long-term decline of steelhead populations in the Sacramento River basin and the Trinity River. Sacramento River steelhead populations have declined from an estimated 28,000 spawners during the 1950s to less than 5,000 spawners in the 1980s (Reynolds et al. 1990). Populations in the Sacramento, Trinity, Feather, and American Rivers are maintained largely by hatchery production.

Steelhead generally spawn in tributary streams, but dams have blocked access to most tributary streams. The distribution and abundance of steelhead is limited by the availability of suitable spawning and rearing habitat in the mainstem rivers where environmental conditions are often dependent on reservoir operations.

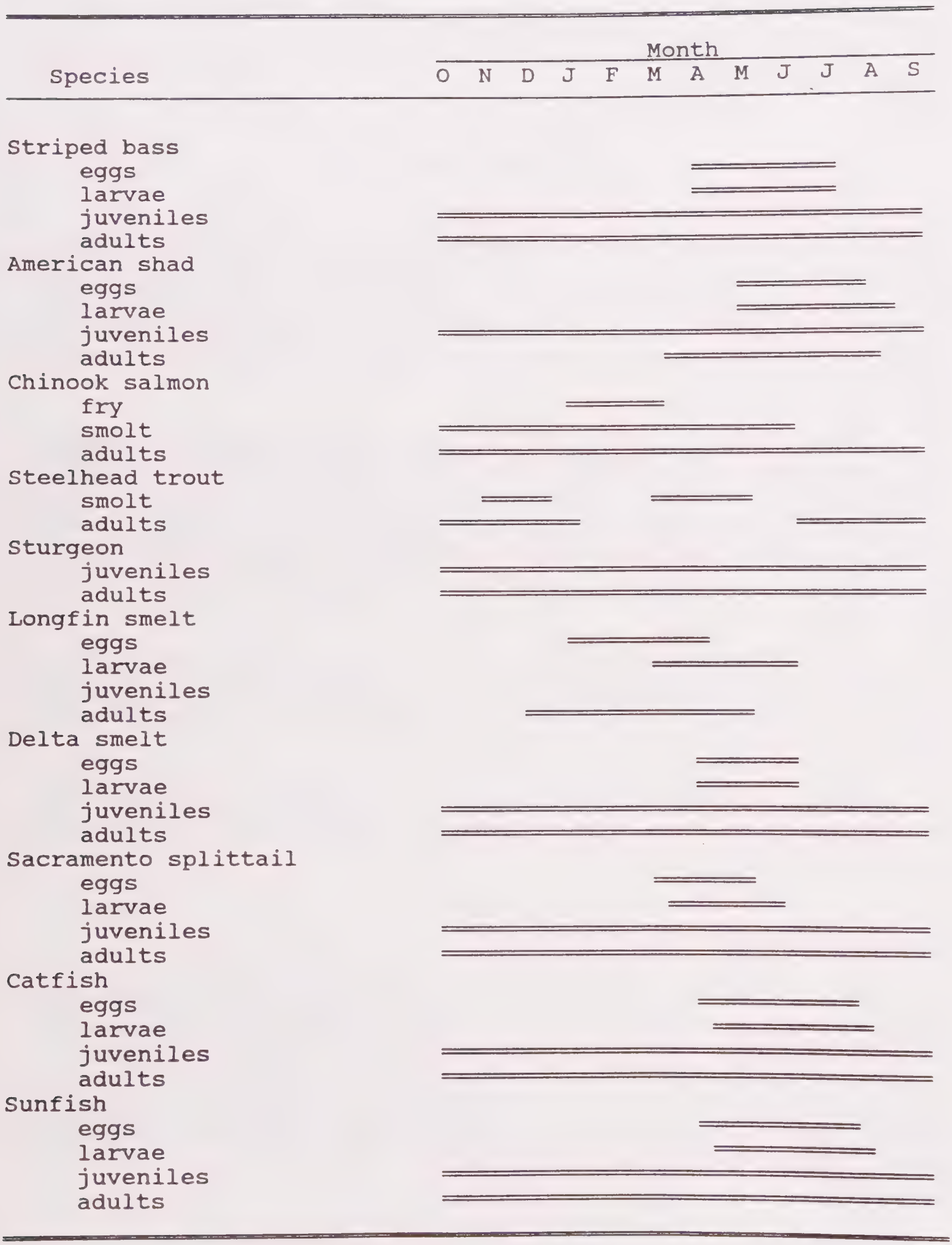
Steelhead trout have water habitat similar to those described for chinook salmon. The factors contributing to their decline are also the same as described for chinook salmon.

Delta

Adult steelhead trout pass upstream through the estuary primarily from August through January; most steelhead proceed up the Sacramento River to spawn. After spawning, adults migrate back down through the estuary from March through June.

Peak outmigration of steelhead trout smolt occurs from March through May, following a riverine rearing period of 1 year or more. Hatchery-reared smolt are generally released in February (Hallock et al. 1961) (Table 2).

Table 2. Approximate Temporal Occurrence of Fish Species by Life Stage in the Delta



Delta Cross Channel operations, lower San Joaquin Riverflow direction, and diversions may have effects on steelhead trout similar to those described for chinook salmon. Steelhead trout have life history requirements similar to chinook salmon; however, steelhead trout have not been as intensely studied as chinook salmon.

Rivers

Steelhead use the Sacramento and Trinity Rivers as migration corridors to and from spawning grounds (primarily on tributary streams) and hatcheries. Steelhead are present in the rivers year round, either as juveniles or migrating adults (Table 1). Most spawning adults move upstream in late fall and winter, and the run generally peaks in January and February (Gerstung 1971). The Trinity River also supports a summer run. Juveniles emigrate during spring after rearing for 2 or more years in upstream areas.

Deleterious water temperature and reduced availability of preferred habitat are probably the most significant environmental factors affecting steelhead trout production in the Sacramento River system (Hallock et al. 1961, Gerstung 1971). Temperatures ranging from 50° to 60°F are adequate for steelhead production (Barnhart 1986). The preferred temperature for juvenile steelhead is believed to be about 59°F.

Water diversions, migration barriers, and pollution have effects on steelhead similar to those described for chinook salmon.

STRIPED BASS

Striped bass spend most of their lives in the ocean or estuary but migrate into fresh water to spawn. California's striped bass production is dependent on conditions in the Bay, the Delta, and the Sacramento River. Commercial fishing of bass is not allowed; however, sport anglers catch about 250,000 fish each year.

The adult striped bass population declined from 3 million fish in the 1960s to about 1 million in the 1980s and about 500,000 fish in 1990 (California Department of Fish and Game 1987c, Stevens pers. comm.). Both juvenile and adult striped bass abundance have declined over the last 20 years (Figure 6 and 7). The 1991 index of 38 mm was the lowest ever estimated in the history of the index. Factors that contribute to reduced survival include direct and indirect affects of water diversions, reduced food availability and egg production, water pollution, predation, fishing (including poaching), and competition with native and introduced species.

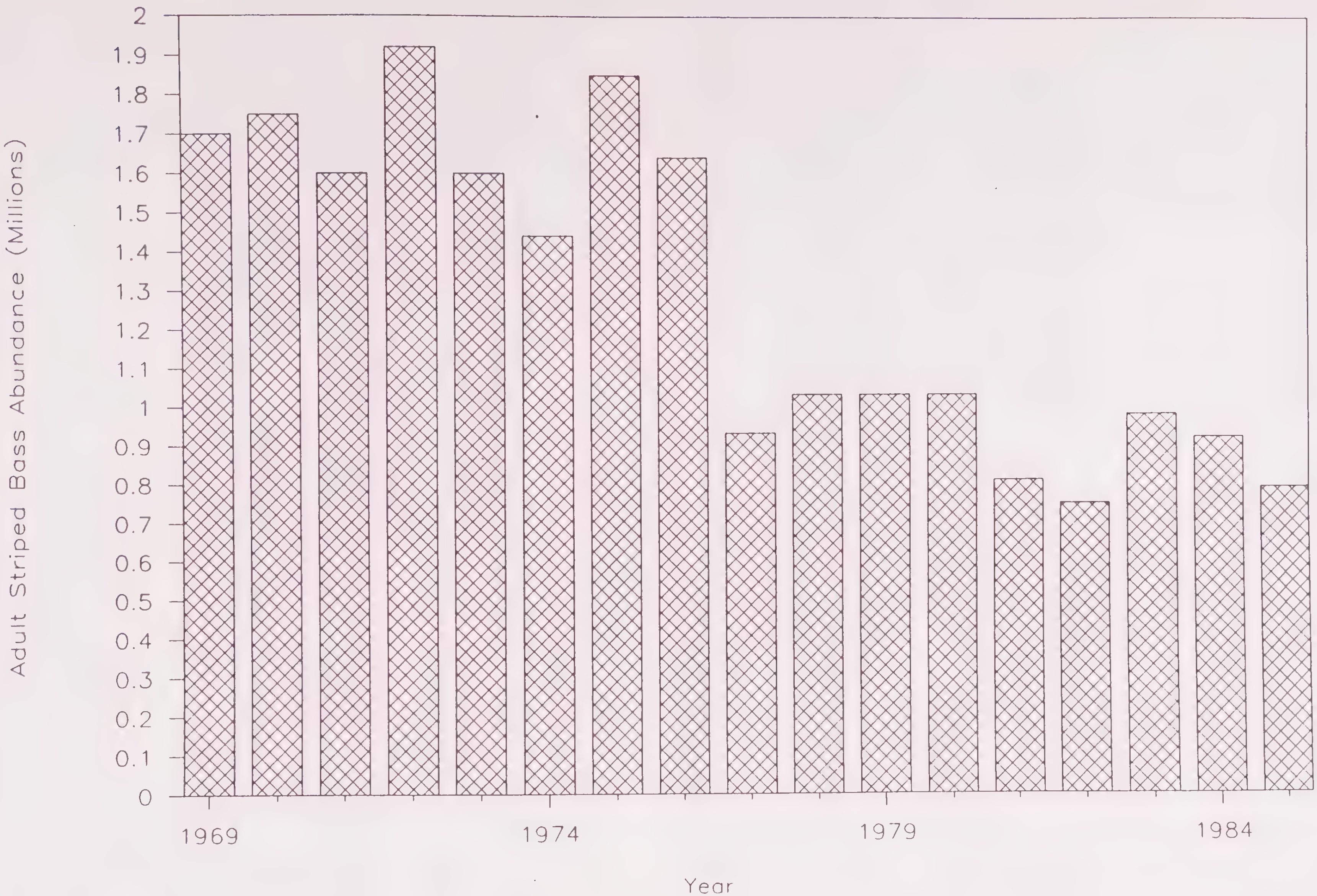


Figure 6. Adult Striped Bass Abundance in the Sacramento-San Joaquin Delta, 1969-1985

Source: California Department of Fish and Game 1987c

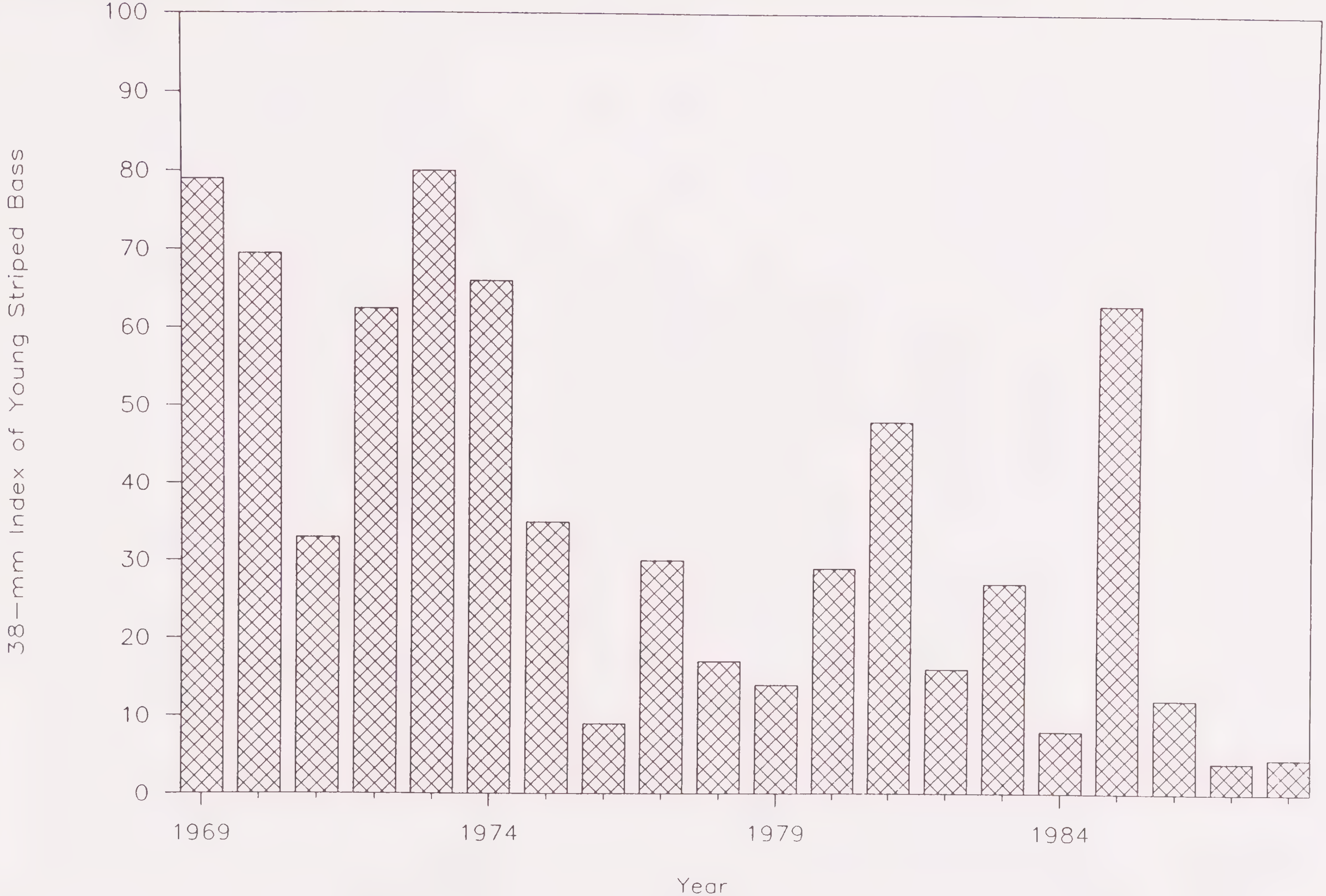


Figure 7. Juvenile Striped Bass Index in the Delta, 1969-1988

Source: California Department of Fish and Game 1987c, Stevens pers. comm.

Since the 1970s, egg production has declined by as much as 90%. This decline is attributable to the overall reduction in abundance, resulting in fewer and younger (smaller sized) female fish. While reduced egg production may reduce year-class strengths, the fecundity of striped bass (i.e., over 500,000 eggs per 6-year-old female), provides the opportunity for substantial population increases (Striped Bass Working Group 1982, California Department of Fish and Game 1987c).

Delta and Bay

Adult striped bass are found in the Delta and Bay throughout the year; however, they begin concentrating in the Bay in fall, primarily San Pablo and Suisun Bays, and move into the Delta and up the Sacramento River during winter and early spring (California Department of Fish and Game 1987c). About 45% of the stock spawns in the Delta during April and May; the remainder spawn in the Sacramento River. Most adults emigrate from fresh water to the ocean by June or July, but many remain in the Bay.

Striped bass broadcast-spawn their semibuoyant eggs in open fresh water, where the eggs drift with the current and hatch in about 2 days (California Department of Fish and Game 1987c). Newly hatched larvae also drift with the current, are carried into Suisun Bay or farther downstream during high Delta outflow.

In general, larval abundance peaks upstream of the entrapment zone, which varies in location from lower Suisun Bay to the lower Delta depending on Delta outflow. The entrapment zone may provide optimum larval fish habitat because of increased food availability. Small particles, including phytoplankton and zooplankton, move downstream more slowly and remain suspended in the water column (i.e., residence time is increased). The importance of the entrapment zone to striped bass production is unknown.

Larvae begin feeding at a length of 5-6 mm (Turner 1987). The initial diet consists of invertebrates including Cladocera (*Bosmina* and *Daphnia*) and Copepoda (*Eurytemora* and *Sinocalanus*), with copepods dominating the diet of 7- to 11-mm larvae. When larvae exceed lengths of 11 mm, *Neomysis* (a mysid shrimp) becomes the primary food organism, dominating the juvenile bass diet for the first 2 years (California Department of Fish and Game 1987c).

Young bass may grow to about 38 mm by July or August. After a year, the juvenile bass measure at least 100 mm. As young bass continue to grow, fish (including other striped bass) comprise a greater proportion of their diet (Stevens 1966).

Young bass become increasingly mobile as they grow and actively move to new locations independent of flow patterns. Juvenile bass disperse throughout the estuary during their second year.

Inflow

During egg and larval life stages, striped bass move with Delta flow. Year class survival appears to be greatest when currents carry young bass out of the Delta and into Suisun Bay (Herrgesell 1990). Higher Delta inflow increases the net movement of water into Suisun Bay.

Delta Cross Channel

Movement of water through the Delta Cross Channel and Georgiana Slough can have both beneficial and deleterious effects on striped bass survival during incubation and larval life stages. As mentioned above, year class survival appears to be greatest when currents carry young bass out of the Delta and into Suisun Bay. For striped bass spawned in the lower San Joaquin River, survival is greatest when the net flow in the lower San Joaquin River is seaward. Net flow direction and volume in the lower San Joaquin River is dependent on riverflow and diversions from the Delta. Flow through the Delta Cross Channel and Georgiana Slough adds to the flow in the lower San Joaquin River. As long as inflow to the lower San Joaquin River exceeds diversions, net flows will be seaward.

Survival of eggs and larvae moving down the Sacramento River, however, is likely lower for the proportion of the population drawn into the Delta Cross Channel and Georgiana Slough with diverted Sacramento River water than for the proportion that continue down the Sacramento River. Movement along the central Delta route delays arrival in Suisun Bay and, if San Joaquin River discharge is low and Delta diversions are high, eggs and larvae may be retained in the central Delta or entrained in SWP and CVP export.

Lower San Joaquin River

Movement of eggs and larvae from the lower San Joaquin River (i.e., part of the central Delta) toward Suisun Bay is dependent on riverflow, Delta Cross Channel and Georgiana Slough flow, and Delta diversions. If net flow in the lower San Joaquin River is landward or only minimally seaward, eggs and larvae will be retained in the central Delta and move south toward the SWP and CVP pumps. Survival of eggs and larvae in the central Delta is low relative to survival in Suisun Bay because of poor rearing conditions and increased entrainment in local diversions and export.

Diversions

Striped bass are most vulnerable to diversion-related mortality from April to mid-July, during egg, larval, and early juvenile life stages (California Department of Fish and Game 1987c). Diversions affect Delta flow patterns and, in combination with Delta inflow volume and Delta Cross Channel and Georgiana Slough flow, affect the movement of eggs and larvae toward Suisun Bay. High diversions are likely to cause flow conditions that

retain a greater proportion of eggs and larvae in the central Delta where survival is reduced relative to survival in Suisun Bay.

The impact of entrainment in diversions depends on population density and distribution, Delta inflow and outflow, and the volume and timing of the diversions. Loss of striped bass more than 18 mm long in diversions by the SWP was shown to have a significant mathematical correlation to volume and direction of flow in the lower San Joaquin River exports of the CVP and SWP pumps, total striped bass abundance, and mean striped bass size (Wendt 1987). Loss of striped bass in diversions is inversely related to net seaward flow in the lower San Joaquin River and directly related to the export volume. As striped bass grow, export has less direct effect on their survival.

Annual egg, larva, and juvenile mortality caused by entrainment is significant and may affect future adult abundance (Turner 1987). Mortality from entrainment alone, however, does not explain the decline in striped bass population (Brown 1987a).

Water Quality

Optimum spawning success generally occurs at salinities of less than 1 part per thousand (California Department of Fish and Game 1987c). The spawning area in the Delta is limited by the salinity gradient, usually located just downstream from Antioch Point, and by agricultural salt concentration in the San Joaquin River above Venice Island.

The health and survival of adult striped bass could be reduced by the level of toxic substances in the estuary. Toxic substances enter the estuary via municipal and industrial discharge and agricultural runoff. Some adult bass have accumulated toxins in their tissues and appear to be in poor health compared to bass populations in other estuaries (Brown 1987b). Although toxic substances may have contributed to striped bass population decline, it seems unlikely that toxics alone are responsible for the long-term decline in abundance; toxic waste treatment and regulatory control over the discharge of toxic substances has increased greatly in recent years. Further studies are needed to better understand any relationship between toxics and striped bass survival and abundance.

Food

Striped bass mortality is highest during the early life stages when the fish are small. If growth is slowed because of insufficient food, larvae are subject to higher mortality rates. First-year growth rates for 1970-74 year classes appear to have declined from pre-1970 levels (California Department of Fish and Game 1987c). A relationship between food availability in the Delta-Bay environment and early striped bass growth, however, has not been shown. The production of food organisms is discussed in greater detail under "Other Species".

Rivers

Approximately 55% of the striped bass population spawns in the Sacramento River above the Delta (California Department of Fish and Game 1966, 1972). The spawning area extends from Isleton to Butte City and most spawning occurs upstream of the confluence with the Feather River. Adult striped bass spawn primarily during late April through June (Table 1).

Semibuoyant eggs are carried downstream near the bottom in midchannel and generally reach the Delta within a few days after spawning. Most eggs hatch between Courtland and Sacramento.

Adult striped bass are found year round in the lower American River, but their abundance peaks during summer, coinciding with the outmigration of adults that spawned in the Sacramento River (Gerstung 1971, DeHaven 1980). Striped bass spawning has not been observed in the American River.

During the second year after hatching, young bass may move upstream from the Delta and into the Sacramento River. Some juveniles are found in the lower Sacramento, Feather, and American Rivers year round.

AMERICAN SHAD

American shad, like chinook salmon, steelhead trout, and striped bass, are anadromous and support sport fisheries during their freshwater migration. Population estimates are unavailable; however, abundance is believed to have declined since the 1960s.

Adult American shad migrate into fresh water from the ocean and the Bay during March, April, and May (California Department of Fish and Game 1987d) (Tables 1 and 2). The adults actively feed during their migration, preying on *Neomysis* and various cladocerans (Stevens 1966). Spawning begins in May and continues into early July (California Department of Fish and Game 1987d). After spawning, the adults leave the spawning grounds and return to the Bay and ocean by September.

The primary spawning grounds are in the upper Sacramento, Feather, Yuba, and American Rivers, although shad may spawn in the northern Delta and the northern portion of Old River (California Department of Fish and Game 1987d). Shad broadcast-spawn their eggs and sperm into the currents, where the semibuoyant eggs sink slowly and drift with the flow. The eggs hatch in 4-6 days and the growing larvae begin feeding on copepods and cladocerans. Ganssle (1966) reported *Neomysis*, copepods, larval fish, and *Corophium* to be the primary prey of young-of-the-year American shad.

The young shad do not drift with the currents, but actively maintain their position. Shad spawned in the Sacramento River system generally rear in the tributary rivers and mainstem downstream from the spawning area. Shad spawned in the Delta appear to rear primarily in the Delta. The locations of major rearing areas vary from year-to-year and seem to be dependent on riverflow (i.e., high flows transport the eggs and larvae farther downstream) (California Department of Fish and Game 1987d).

Most juvenile American shad emigrate from their freshwater rearing areas and enter the Bay between September and December (Stevens 1966). Timing of the seaward outmigration is probably dependent on fish size (they usually emigrate when they reach 50-150 mm), although outmigration of remaining shad may be triggered by declining water temperatures (Chittendon 1982). By January, most juveniles have migrated to the ocean but some remain in the estuary until they mature.

Delta

American shad abundance may be affected by factors similar to those that affect striped bass. Fall abundance of young-of-the-year shad is correlated with mean Delta outflow during April, May, and June (California Department of Fish and Game 1987d). The highest juvenile abundance, which varies more than an order of magnitude from year to year, occurs in years with high riverflows during the spawning and rearing periods (Stevens et al. 1983). The cause of increased juvenile abundance following high spring flows is unknown. Adult population estimates are unavailable to allow the relationship between young-of-the- year and adult abundance to be determined.

American shad is the third most common fish entrained at the SWP and CVP pumps (California Department of Fish and Game 1987b). Newly metamorphosed juveniles are entrained during July and are probably the progeny of adults that spawned in the Delta. Undoubtedly, eggs and smaller larvae are also entrained, but these are not salvaged at the SWP and CVP fish facilities.

Entrainment during fall affects juveniles 50-150 cm long. The majority of these fish are probably the progeny of upstream-spawning adults that are diverted toward the pumps during their outmigration. Proportions of Sacramento River water diverted through the Delta Cross Channel and Georgiana Slough and flows in the lower San Joaquin River are factors that may affect the proportion of the juvenile population entrained at the export pumps.

Rivers

The mainstem Sacramento River is an important spawning habitat for American shad. A substantial proportion of the adult population, however, spawns in tributary streams (the American, Feather, and Yuba Rivers). Run size in tributaries depends on flow in each

river during adult upstream migration (Painter et al. 1977). The number of first-year spawners that enter a tributary to spawn is greater if tributary flow is high relative to Sacramento Riverflow.

DELTA SMELT

Delta smelt are native to the estuary. Since 1981, the population has been generally lower than in the 1970s. The relatively low numbers of smelt precipitated proposed listing as threatened or endangered under the federal Endangered Species Act (U.S. Fish and Wildlife Service 1991). Considerable variability in population estimates over the years and lack of information on factors affecting abundance led to the decision by the California Fish and Game Commission not to place the Delta smelt on the state endangered species list. One indicator of abundance and variability in population size since 1968 is the annual midwater trawl indices (Figure 8).

Smelt range from the Delta into Suisun Bay, where they generally school in open surface waters (Moyle 1976). Smelt migrate into the upper channels of Suisun Bay and the lower reaches of the Delta in fall. Smelt spawn in dead-end sloughs and channels during February through June where the adhesive eggs are deposited over submerged tree branches or sandy and rocky substrate (Radtke 1966, Wang 1986 and Stevens et al. 1990). Eggs hatch in 12-14 days (Stevens et al. 1990).

Delta smelt grow rapidly and reach sexual maturity within the first year. The population is probably more sensitive to short-term environmental changes than other species because they usually do not live beyond 1 year and spawning failure in 2 successive years could eliminate the species. Smelt feed primarily on copepods, insect larvae, and *Neomysis*.

Many of the factors discussed for other species may also affect smelt abundance. Factors of primary concern include loss of habitat (caused by changes in flow patterns and salinity distributions), entrainment in local diversions and export, decreased spawning population abundance, invasions of exotic phytoplankton and invertebrates, and decreased food availability (Stevens et al. 1990).

Assuming that salvage is indicative of vulnerability to entrainment, Delta smelt are most vulnerable during May, June, and July (Figure 9). March and April are also likely periods of high vulnerability to entrainment; however, smelt would be small (less than 20 mm long) and would not be salvaged at the SWP and CVP fish facilities.

Stevens and Miller (1983) found that wide fluctuations in abundance of Delta smelt are not significantly correlated with Delta outflow. Smelt abundance may be related to Delta outflows but the relationship could be obscured by the possible effect of outflows on both abundance and distribution patterns (Stevens et al. 1990). Other factors such as food availability and predation by striped bass and other fish species may contribute to the variability in smelt abundance.

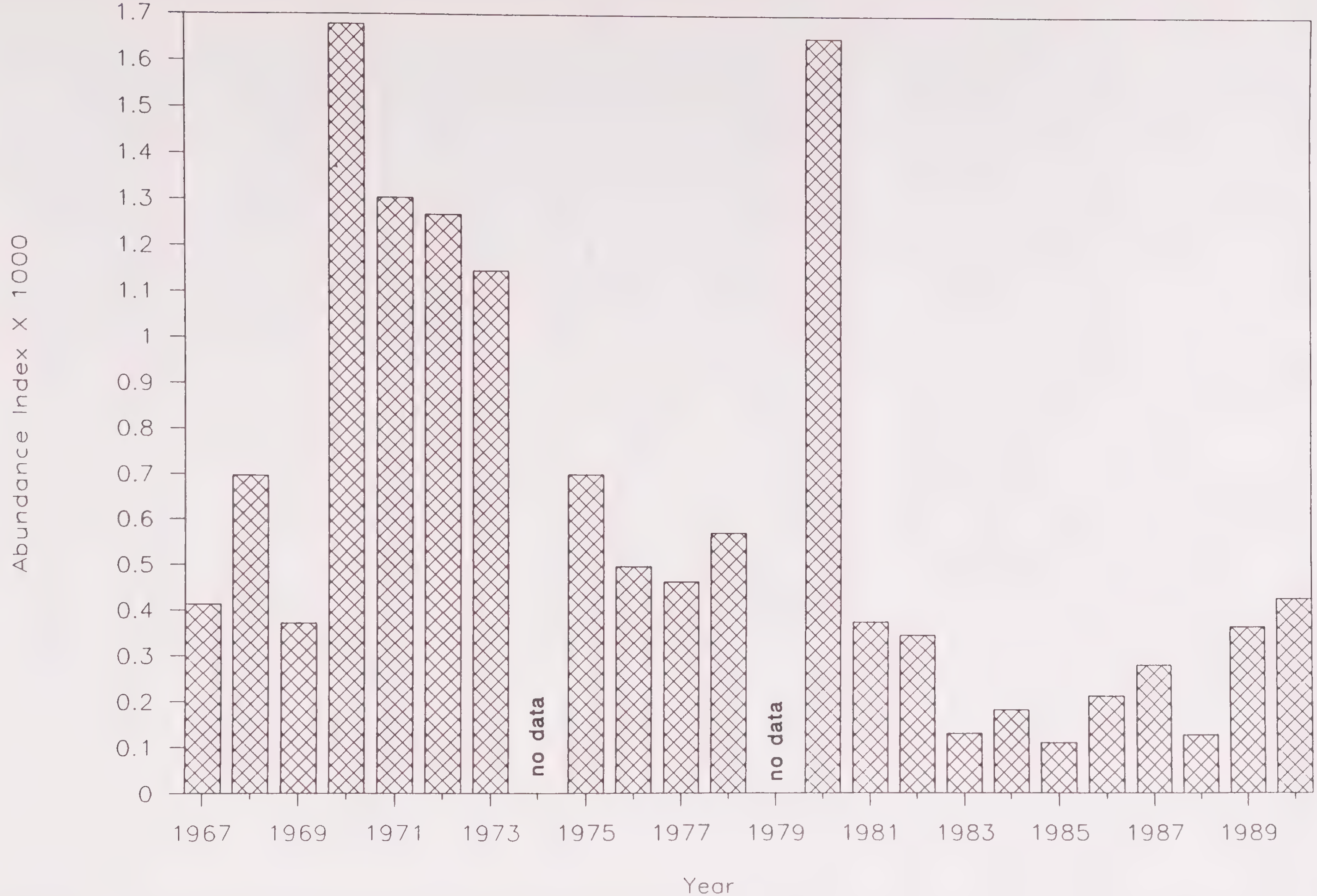


Figure 8. Annual Fall Midwater Trawl Indicies for Delta Smelt 1967–1990

Source: Stevens, Miller, and Bolster 1990

Figure 9. Average Monthly Salvage of Delta Smelt at the State Water Project Fish Protection Facility, 1968-1989

Source: Stevens, Miller, and Bolster 1990

OTHER RESIDENT AND MIGRATORY SPECIES

Information on the project area, additional species, and the effect of CVP and SWP operations on food organisms is discussed below.

Kellogg Creek Watershed and Vicinity

Brushy, Marsh, and Kellogg Creeks are the major streams in the area near the Kellogg Creek watershed. Kellogg Creek flows from southwest to northeast and into the Delta near Indian Slough. Stock ponds are scattered throughout the watershed.

Typical of western San Joaquin Valley streams, flow in Brushy, Marsh, and Kellogg Creeks is highest during rainy periods in winter and spring. Flows become intermittent by midsummer and resident fish are confined to permanent pools until the following rainy season. Most of the tributary streams are dry during summer. Livestock grazing in the area has increased nutrient and turbidity levels in the streams, accelerated erosion, and degraded the riparian vegetation along the channel banks (California Department of Fish and Game 1983).

Surveys of streams in the watershed area in 1980 found native and introduced fish species that are tolerant of slow-moving water, low oxygen levels, warm temperatures, and dense algal growth. The 11 fish species found in Kellogg, Brushy, and Marsh Creeks were hitch, Sacramento blackfish, threespine stickleback, Sacramento sucker, green sunfish, mosquitofish, roach (*Lavinia symmetricus*), bluegill, largemouth bass, black crappie, and brown bullhead. In Kellogg Creek, the numerically dominant species was hitch, followed by Sacramento blackfish, stickleback, Sacramento sucker, and green sunfish (California Department of Fish and Game 1983). Hitch and green sunfish were the only fish species present in Marsh Creek, while only mosquitofish were present in Brushy Creek.

Fish are present in stock ponds that contain water of sufficient depth and quality suitable for fish survival. The six species found in stock ponds within the project area were hitch, bluegill, mosquitofish, largemouth bass, brown bullhead, and black crappie. The most abundant species was hitch (California Department of Fish and Game 1983).

Delta and Rivers

Significant numbers of resident fish are entrained by water diversions, but the actual entrainment impact on populations cannot be determined because information on population size, screening efficiency (except for a few species), and indirect entrainment losses is unavailable. Based on movement patterns and habitat affinities, open water pelagic fish (i.e., threadfin shad, Delta smelt) are probably most susceptible to entrainment in

diversions, followed by bottom-feeding catfish and minnows; sunfish have the lowest susceptibility to entrainment because of their territorial habitat associations with channel banks and bottoms.

Sacramento Splittail

The Sacramento splittail, native to the estuary, has experienced significant decline in its distribution and abundance and is being considered for listing as threatened or endangered under the federal Endangered Species Act (Lorentzen 1987). Sacramento splittail range from the lower reaches of the Sacramento and San Joaquin Rivers, through the Delta, and into Suisun and San Pablo Bays (Caywood 1974, Wang 1986). Splittail inhabit slow-moving waters of the main channels and backwater sloughs and tolerate brackish water.

From early February to July, adhesive eggs are broadcast-spawned over flooded streambank vegetation or over beds of aquatic plants (Caywood 1974, Moyle 1976, Wang 1986). Larvae remain in the shallow, weedy areas where spawning occurred. Juveniles move into deeper waters and feed on detritus, *Neomysis*, pelecypods, and amphipods.

Factors affecting abundance may include those discussed for other species, but data on the response of splittail populations to changes in environmental factors are unavailable.

Sturgeon

Two species of sturgeon inhabit the Delta and Bay environment through-out the year and are believed to have similar environmental requirements. The white sturgeon is more abundant and therefore better understood than the green sturgeon. Spawning occurs in spring, primarily in the Sacramento River, and adults return to the estuary after spawning. Juvenile sturgeon are found throughout the Delta, although they are most abundant in the Sacramento River (Radtke 1966).

Factors affecting sturgeon abundance are relatively unknown, but the population appears to be increasing. Sturgeon are entrained in diversions and annual salvage at the SWP screens totals about 3,000 fish. The primary food items of juveniles in the Delta are the amphipod *Corophium* and the mysid *Neomysis*.

Freshwater Resident Species

Three major groups, sunfish (*Centrarchidae*), catfish (*Ictaluridae*), and minnows (*Cyprinidae*), dominate the freshwater resident species of the Delta (California Department of Fish and Game 1987e). Sunfish (i.e., bluegill and largemouth bass) are most abundant in the eastern Delta but are found throughout the freshwater portions of the estuary. Generally, sunfish species are most abundant in transport channels (i.e., channels where net flow is often reversed or intensified relative to the natural flow pattern because of water

export), which may reflect a preference for the greater amounts of aquatic vegetation that occur there (California Department of Fish and Game 1987e). All the species spawn in spring and summer and lay adhesive eggs in nests on the bottom. The sunfish diet varies with size and species, but *Neomysis*, *Corophium*, isopods, and copepods are important in the diet of small juveniles (Turner 1966a). Fish and crayfish become more important prey items as fish increase in size.

White catfish are more than 35 times more abundant, on average, than any of the other catfish species in the Delta (California Department of Fish and Game 1987e). White catfish is the dominant fish species in the south Delta, where its abundance is correlated with low water transparency and high electroconductivity. Catfish generally spawn in summer and lay their adhesive eggs in nests on the bottom. *Corophium* is the most important item in the diets of all catfish species, especially juveniles (Turner 1966b). *Neomysis*, other amphipods, and isopods are also eaten by small juveniles, while larger juveniles and adults consume fish, crayfish, and Asian clams.

The most abundant minnows (e.g., carp, goldfish, and golden shiner) are introduced. Native minnows include hardhead, hitch, Sacramento squawfish, and Sacramento blackfish. Less is known about this group than the others.

Factors affecting abundance of freshwater species may include those discussed previously for other species, but data on the response of resident fish populations to changes in environmental factors are unavailable.

Food

Food could be a major factor limiting the abundance, distribution, and production of all Delta fish species. Phytoplankton (algae that live suspended in the water column) is the base of the food chain for vertebrate and invertebrate species in the Delta and Bay. Zoobenthos (invertebrates that live on or in the bottom substrates), zooplankton (invertebrates and fish larvae that live suspended in the water column), and smaller fish (migratory and resident) are important organisms in the diet of Bay and Delta fish species.

The rapid increase in abundance of recently introduced species, including zoobenthos (e.g., *Potamocorbula*), zooplankton (e.g., *Sinocalanus*), and fish species (e.g., yellowfin and chameleon goby), could change food availability to other Bay/Delta species and reduce survival and abundance.

Phytoplankton. Output of riverine phytoplankton to the Suisun Bay and primary productivity in the Suisun Bay may be important factors affecting food availability for Bay/Delta species. Production and availability of phytoplankton may be partially determined by the level of Delta outflow; however, the mechanisms regulating the level of phytoplankton production are not fully understood.

An important food source to the Bay may be input of organic carbon from riverine algal production. Although the effects of hydrologic and hydrodynamic conditions in the rivers and Delta on phytoplankton productivity are complex and poorly understood, input of riverine phytoplankton is at least partially controlled by the volume of Delta outflow.

Environmental conditions affect species composition of algal communities and overall productivity. Change in algal species composition could affect the abundance of dependent zooplankton. In recent years, the chain-forming diatom, *Melosira*, has periodically occurred at very high densities. During periods of high *Melosira* density, some zooplankton (copepods) quit feeding, possibly affecting zooplankton abundance through changes in survival and reproductive rates (Orsi 1988). The cause of periodic high *Melosira* density is unknown.

The location of the entrapment zone is determined by Delta outflow. The entrapment zone is an area of high organic carbon because circulation increases residence time (i.e., particles, including phytoplankton and zooplankton, are resuspended and are flushed downstream more slowly). Productivity in the entrapment zone is negative (i.e., respiration exceeds photosynthesis), primarily because depth and turbidity reduce light penetration.

Primary productivity in the entrapment zone and vicinity is highest when the zone is located near large shoal areas, such as those in San Pablo and Suisun Bays, rather than in deep channels, such as in Carquinez Strait or in the Delta. In Suisun and San Pablo Bays, tidal mixing carries phytoplankton suspended by entrapment zone circulation into shoal areas. The shoal areas are shallow, and a larger proportion of the water column relative to the main channel where the entrapment zone is located receives sufficient light to enable photosynthesis. Productivity in the shoal areas is positive (i.e., photosynthesis exceeds respiration).

Zoobenthos. Salinity appears to influence distributions and densities of benthic populations. The relatively stable salinity regime of the interior Delta appears to enable a greater diversity of benthic populations to persist at lower densities. Greater variability in densities of zoobenthos in the western Delta and Suisun Bay is caused by periodic large freshwater outflows and variable salinity. Markmann (1986) found that the western Delta supported the highest benthic population densities, although they were highly variable, and that peak densities usually occur in June and July.

Corophium, an abundant amphipod commonly eaten by many fish species (Ganssle 1966, Hazel and Kelley 1966, Radtke 1966, and Turner 1966a, 1966b), decreased in abundance in the western Delta during dry conditions (e.g., 1976 and 1977). The reduced abundance of *Corophium* enabled temporary colonization by species tolerant to higher salinity (Markmann 1986). Delta outflow and flow patterns affect seasonal salinity distributions in the Delta.

The lowest benthic population densities occur in either very slow or very rapid currents (Markmann 1986). High current velocity (greater than 2 or 3 fps) can remove bottom substrates and benthic organisms. Slow currents (less than 0.5 fps) may not

transport sufficient detrital materials to sustain benthos feeding on the surface of substrates. Delta inflow, Delta Cross Channel and Georgiana Slough flow, and Delta diversions affect local current velocities. *Potamocorbula*, a clam species, was introduced to the Bay about 1986 and now occurs throughout the Bay (Moyle 1989). High *Potamocorbula* population densities and filtration rates have reduced phytoplankton abundance in Suisun and San Pablo bays. Although the clam may provide food for some species, such as sturgeon, reduced phytoplankton abundance may cause a decline in zooplankton populations that feed on phytoplankton and ultimately affect the abundance of fish species (e.g., striped bass and Delta smelt) dependent on the availability of zooplankton.

Zooplankton. Long-range movement of zooplankton is largely controlled by the movement of the water mass. Zooplankton are more important than zoobenthos in the diet of many of the fish species discussed (Radtke 1966, Turner 1966a, 1966b, California Department of Fish and Game 1987c, 1987d, 1988, and Dettman and Kelley 1987).

Neomysis is probably the single most important zooplankton species in the diet of Delta and Suisun Bay fish. *Eurytemora*, other copepods, and cladocerans may be equally important, depending on the life stage of the fish feeding on them and the abundance of other zooplankton.

Neomysis has been abundant in only 2 years since 1977; both years were characterized by high spring outflow (California Department of Fish and Game 1987f). Some of the annual fluctuations in abundance of this organism and shifts of population distribution between Suisun Bay and the Delta can be attributed to variations in Delta outflow. Outflows regulate water residence times, the position of the entrapment zone and the salinity gradient, and the distribution of *Neomysis*. Movement of the entrapment zone and salinity gradient into the Delta reduces the habitat area available to *Neomysis* (Orsi and Knutson 1979 and Arthur and Ball 1980).

The highest *Neomysis* densities occur between salinities of 1.2 and 2.6 parts per thousand (Knutson and Orsi 1983). The relationship between *Neomysis* density and salinity is probably attributable to estuarine circulation patterns, light, and tidally influenced vertical migrations that concentrate *Neomysis* in the entrapment zone.

Abundance of zooplankton in the Delta has been reduced by increased flow velocities in the Delta channels, reduced water residence times, and transport of zooplankton-deficient Sacramento River water into the central and south Delta (California Department of Fish and Game 1987f). Food availability (phytoplankton) and competition and predation by introduced species may also have contributed to the decline in native zooplankton abundance.

Introduced species may displace or consume native species, reducing abundance of native species and the availability as prey for fish species that may depend on them. A native copepod species, *Eurytemora*, a preferred food of striped bass larvae, has declined while an introduced species, *Sinocalanus*, has increased (California Department of Fish and

Game 1987e). *Sinocalanus* may have less dietary value for striped bass and are more difficult for larval bass to capture than *Eurytemora*.

Bay

The Bay includes habitats in Suisun, San Pablo, and San Francisco Bays. The following information, unless otherwise indicated, is summarized from studies by California Department of Fish and Game (1987g).

Over 100 species of fish are found in the Bay, including marine, estuarine, and freshwater species listed for Suisun and San Pablo Bays. The Bay is an important nursery area for marine and estuarine species, including bay shrimp (*Crangon franciscorum*), Dungeness crab (*Cancer magister*), northern anchovy, Pacific herring, and English sole. Organisms use the Bay as a nursery area because survival and growth is increased relative to survival and growth in the marine environment. Predation and parasitism are reduced because of increased turbidity, abundant submerged vegetation, and lowered salinity. River inflow is rich in nutrients and other food sources that enhance food production and availability in the Bay.

Delta outflow can influence abundance and distribution of fish and invertebrates in the Bay, but the response of organisms to outflow is species and life-stage dependent. The variability in the response of organisms to different outflow levels may be an important factor in the dynamics of the estuarine community.

The effect of Delta outflow pulses on organisms in the Bay is determined by the timing and magnitude of the pulses. Outflow pulses during October-December are generally less than 50,000 cfs, while pulses during January to March may be much larger. Spring snowmelt contributes to moderate outflow pulses during April to June.

Delta Outflow Effects on Abundance

The cause-and-effect relationship between flows and organism abundance is complex, often dictated by a chain or web of events rather than by direct effects. Although some correlations between flows and organism abundance have been identified, the factors that cause the correlations are unknown.

The abundance of bay shrimp juveniles and adults, longfin smelt juveniles, English sole larvae, and some other species is positively correlated with increased Delta outflow. Increased Delta outflow is most affected during spring by operations of upstream water projects, including the SWP and CVP.

The abundance of Dungeness crab juveniles, English sole juveniles, northern anchovy eggs, and some other species in the Bay is negatively correlated with increased Delta outflow. In general, the abundance of those organisms that spawn in winter and spring in the Bay correlated negatively with outflow.

Of the Bay species of fish and invertebrates studied, 29% are more abundant in wet years than in the dry years, 10% are more abundant in the dry years, and 61% are unaffected by water-year-type. Nearly all of the common estuarine species, including bay shrimp, longfin smelt, and starry flounder, were more abundant in wet years. Abundance of most marine pelagic species is not correlated with outflow changes.

Delta Outflow Effects on Distribution

Fish and invertebrate species actively or passively changed location when Delta outflow levels changed. Change in distribution, however, does not necessarily mean that abundance changes.

Increased Delta outflow expanded the distribution of longfin smelt, English sole larvae, and other species in the Bay. Distribution of some species, including bay shrimp, Pacific herring, northern anchovy, and English sole juveniles, was reduced under increased outflow conditions (i.e., species were found in fewer locations).

Mechanisms of Abundance and Distribution Changes

Three general parameters that are affected by Delta outflow and that may affect abundance and distribution of some Bay species are salinity, direct transport by currents, and nutrient levels. The effects of outflow on physical, chemical, and biological conditions are greatest in Suisun Bay, lesser in San Pablo Bay, and the least at the mouth of the Bay near the Golden Gate Bridge.

Mobile fish and invertebrates respond to salinity changes by moving away from areas where salinity is less conducive to survival and into areas more favorable. Changes in salinity may eliminate less mobile species and, if changes are long-term, enable colonization by new species. Salinity in the Bay south of the Golden Gate Bridge is notably affected only at Delta outflows greater than 35,000 cfs (Smith 1987).

Currents associated with Delta outflow may directly or indirectly increase dispersal of a species (especially eggs, larvae, and young) in the estuary, decreasing competition between and among species (Stevens and Miller 1983). The strength of gravitational circulation, the cause of net landward flow in near-bottom currents, is partially determined by Delta outflow volume (Smith 1987). Gravitational circulation transports larvae of species that spawn in the ocean into the Bay (e.g., English sole).

Water residence time in the Bay is determined by several factors, including tides, local inflow, and Delta outflow (Smith 1987). Water residence times in Suisun and San

Pablo bays range from weeks at Delta outflows of approximately 4,000 cfs to days at outflows of approximately 30,000 cfs. In the Bay south of the Golden Gate Bridge, water residence times range from months during low Delta outflows (4,000 cfs) to weeks at high Delta outflows (350,000 cfs). Longer residence may reduce the dispersal of Bay organisms and concentrate pollutants discharged into the Bay from municipal, industrial, and agricultural sources.

Delta outflow is a source of nutrients, and flow-regulated nutrient levels may affect abundance of Bay organisms. Turbidity and the extent of salinity stratification may overshadow the effects of nutrient input. The degree to which nutrient input from Delta outflow contributes to Bay productivity is unknown.

Reservoirs

CVP and SWP reservoirs, including Clair Engle, Shasta, Folsom, Millerton, New Melones, and Oroville, provide an important component of freshwater angling in California. These reservoirs have greatly increased warmwater game fish production (primarily centrarchids); however, large, self-sustaining game fish populations are uncommon in reservoirs. Periodic stocking to meet sport fishing demands is usually required to maintain some game fish populations because reproductive success is limited by water level fluctuations and declining elevations during late spring (Leidy and Myers 1984).

Because reservoirs are used to provide flood control, hydroelectric power generation, and water supplies, options available to address extreme water-level fluctuations are often limited by operating constraints. Water-level fluctuations change several physical and chemical parameters that adversely affect reservoir populations of bacteria, phytoplankton, zooplankton, macrophytes, and fishes by influencing biomass production, species composition, distribution, and yield.

Adverse effects on spawning sport fishes, such as largemouth bass, occur when water levels increase or decrease in shallow spawning areas during the spawning, incubation, or rearing periods. Nests may be dewatered or declining water levels may force adults to abandon nests, exposing eggs and juveniles to increased predation. Declining water levels often eliminate desirable shoreline habitat that provides structural cover for juvenile fishes (e.g., riparian and rooted aquatic vegetation and rocks).

FISHERIES MONITORING, ENHANCEMENT, AND HABITAT IMPROVEMENT ACTIONS

Reclamation and DWR are participating in actions to increase survival rates, reproductive success, and abundance of fish in the Sacramento and San Joaquin River systems and Delta. In addition, they are participating in studies to improve the quality and

availability of information on the biology and ecology of fish populations in the Sacramento and San Joaquin River systems, Delta, and Bay.

Activities being undertaken by Reclamation include:

- funding USFWS studies on the effects of flow releases from New Melones Reservoir on chinook salmon in the Stanislaus River;
- implementing USFWS and NMFS recommendations for mitigating fish passage problems at Red Bluff Diversion Dam, including construction of fish screens, ladders, and traps;
- opening the Red Bluff Diversion Dam gates from December 1 to April 1 to allow unimpeded passage of migrating adult chinook salmon, especially winter-run chinook salmon;
- increasing discharge from Keswick Dam in coordination with the release of smolts from the Coleman National Fish Hatchery;
- releasing water from the low-level outlets on Shasta dam to reduce water temperature to protect winter-run chinook salmon in the Sacramento River;
- releasing cooler Trinity River water from Keswick Dam to protect fall-run chinook salmon in the Sacramento River;
- funding the Shasta temperature-control study and developed plans for installation of a selective withdrawal structure on Shasta dam to provide flexibility in controlling the temperature of released water;
- funding purchase and placement of spawning gravel in the Sacramento River downstream of Keswick Dam;
- releasing water from Shasta Reservoir to dilute toxic runoff from Spring Creek and prevent fish kills in the Sacramento River;
- funding modernization of the Trinity River Fish Hatchery; and
- funding fisheries studies in the Sacramento-San Joaquin Estuary, including real-time monitoring of striped bass movement down the Sacramento River.

Activities undertaken by DWR include:

- installing pumps on Mill Creek to provide groundwater for agricultural irrigation in lieu of diversions during the migration of adult and juvenile spring-run chinook salmon;

- restoring and replacing spawning gravel on Mill Creek, the upper Sacramento River, Merced River, and Tuolumne River;
- funding the modernization of Merced River Fish Hatchery;
- purchasing striped bass and steelhead juveniles to replace losses to entrainment in SWP diversions; and
- funding Delta smelt and striped bass studies and population monitoring.

Section B-7. Fisheries Impact Assessment Methodology

GENERAL IMPACT ASSESSMENT METHODOLOGIES

Municipal, industrial, and agricultural water users obtain water directly from the Delta channels. A change in Delta diversions may alter Delta flow patterns, Delta outflow volume, and upstream conditions, including reservoir storage, river discharge, and river water temperature. Changes in physical and chemical conditions affect fish populations in the Sacramento-San Joaquin and Trinity River systems and in the Sacramento-San Joaquin Delta and San Francisco Bay.

Evaluation of the potential effects of possible alternative projects and operations on fisheries resources is based on reviews of existing literature, contacts with appropriate agency experts, and analysis of available data. Flow and water quantity information used in the analysis are output from either the U.S. Bureau of Reclamation Central Valley Simulation Model (PROSIM) or the California Department of Water Resources Central Valley Simulation Model (DWRSIM). Delta flow patterns and salinities are calculated by either the RMA Delta model or the Fisher Delta model using flow data from either DWRSIM or PROSIM. Conditions for the 1922-1978 period are simulated for each alternative, including simulations under present and future demands.

At a minimum, Delta flow patterns, diversion rates, and outflow are evaluated for each project alternative. The level of evaluation depends on the magnitude of change from the no-action condition (existing), historic effect of a hydrologic or temperature condition on fish populations, and on the sensitivity of fish to the changed condition. Physical and chemical conditions that are unchanged from the no-action condition under alternative operations are excluded from further analysis.

Species

The major species included in the impact analysis are chinook salmon, striped bass, American shad, Delta smelt, Sacramento splittail, and longfin smelt. Impacts and benefits are identified for these species because of their importance to commercial and sport fisheries, the sensitivity of the species to environmental conditions affected by water project operations, and the historic decline in population abundance potentially attributable to habitat loss and degradation. Adverse and beneficial effects of project operations on species included in the impact analysis apply to species with similar life histories (i.e., effects on steelhead trout are the same as effects described for chinook salmon).

Impacts on American shad, Sacramento splittail, and longfin smelt are assessed qualitatively by evaluating changes in hydrologic and hydrodynamic conditions relative to the spacial and temporal distribution of species life stages. Impacts on chinook salmon and striped bass are evaluated qualitatively and quantitatively.

Environments

The fisheries environment potentially affected by water project operations is divided into four macroenvironments: Delta, Bay, rivers, and upstream reservoirs. Physical and chemical conditions in each macroenvironment are evaluated independently, except for river water temperature, which is influenced by project operations through changes in riverflow and reservoir storage; and Delta salinity, which is influenced by project operations through changes in Delta flow conditions and the location of the salinity gradient in the Bay.

Delta

The general conditions that could be affected by water project operations include Delta flow patterns, diversions, inflow, and water quality (Table 1).

Flow Patterns. Effects on flow patterns will depend on the volume of Delta inflow, the source and relative composition of inflow (i.e., Sacramento, San Joaquin, and Mokelumne Rivers), and the volume of diversions, especially Central Valley Project (CVP) and State Water Project (SWP) export. In general, the natural flow pattern through the Delta provides the best conditions for maintaining most fish populations (Figure 1).

Diversions, exports, regulated inflow, and channelization and other channel modifications (Delta Cross Channel [DCC]) have altered the natural flow pattern in the Delta. The worst conditions for maintaining fish populations occur when Sacramento River flow is drawn into the central Delta via the DCC, Georgiana Slough, and the lower San Joaquin River, and when reverse flow conditions exist in the lower San Joaquin, Old, and Middle Rivers (Figure 2). The flow patterns shown in Figure 2 occur under existing Delta conditions. Projects that exacerbate reverse and cross Delta flows are considered detrimental to fish and prey organisms because they act to reduce survival and growth of some species (Table 1).

Of special concern is potential change in the proportion of Sacramento River water drawn into the DCC. (Reference to the DCC includes flow in Georgiana Slough.) Salmon entrapped in water drawn into the central Delta via the DCC experience increased mortality relative to salmon that continue down the Sacramento River. Increased mortality may result from increased exposure to predation, Delta diversions, and detrimental temperatures. Other species that normally migrate down the Sacramento River channel, including American shad and striped bass, may also be adversely affected by entrapment in water moving through the DCC.

Table 1. Relationship Between Affected Environmental Conditions and Fish Populations

Environment	Affected Conditions: General	Affected Conditions: Specific	Effect on Fish	Species of Concern
Delta	Flow patterns	Delta Cross Channel Lower San Joaquin River	Survival, growth, migration	Striped bass, chinook salmon, Delta smelt, American shad
	Diversions	CCWD - Rock Slough CCWD - Old River CCWD - Clifton Court Forebay CCWD - Middle River Banks (SWP) Tracy (CVP)	Survival	Striped bass, chinook salmon, Delta smelt, American shad, Sacramento splittail
	Inflow	Sacramento River	Appears to affect survival	Chinook salmon, American shad, longfin smelt
	Water quality	Lower San Joaquin River salinity	Reproduction	Striped bass
Bay	Inflow	Location of the salinity gradient	Survival, growth, reproduction	Striped bass, Delta smelt
		Change in flushing efficiency	Survival, growth, reproduction, migration	Striped bass
Rivers	Discharge	Trinity River Sacramento River American River	Survival, growth, reproduction, migration	Chinook salmon, steelhead trout, American shad
	Temperature	Trinity River Sacramento River American River	Survival, growth	Chinook salmon, steelhead trout
Reservoirs	Storage	Clair Engle Shasta Folsom	Survival, growth, reproduction	Centrarchids, salmonids

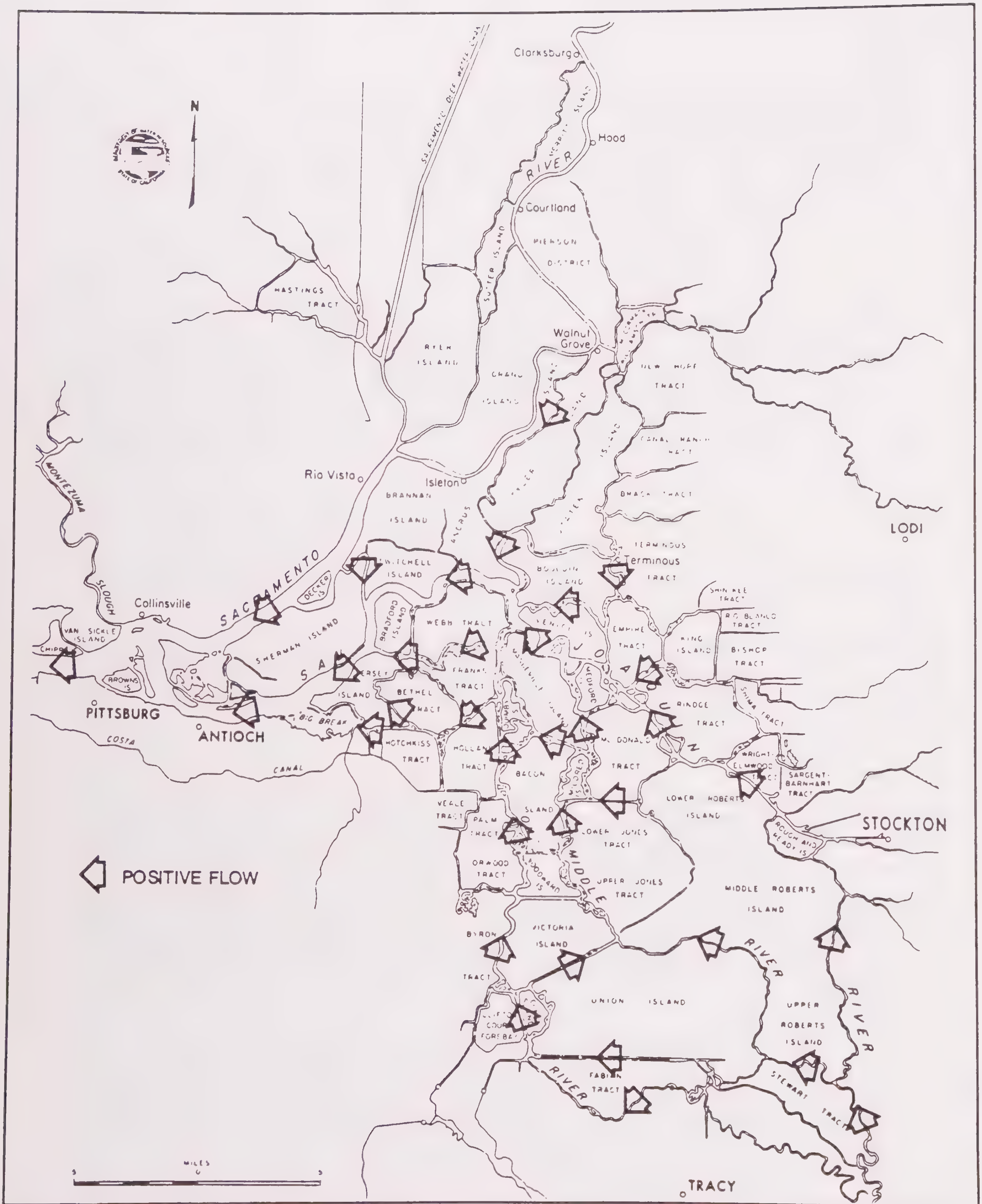


Figure 1. Delta Flow Patterns Under High Flow Conditions and No Export (California Department of Water Resources)

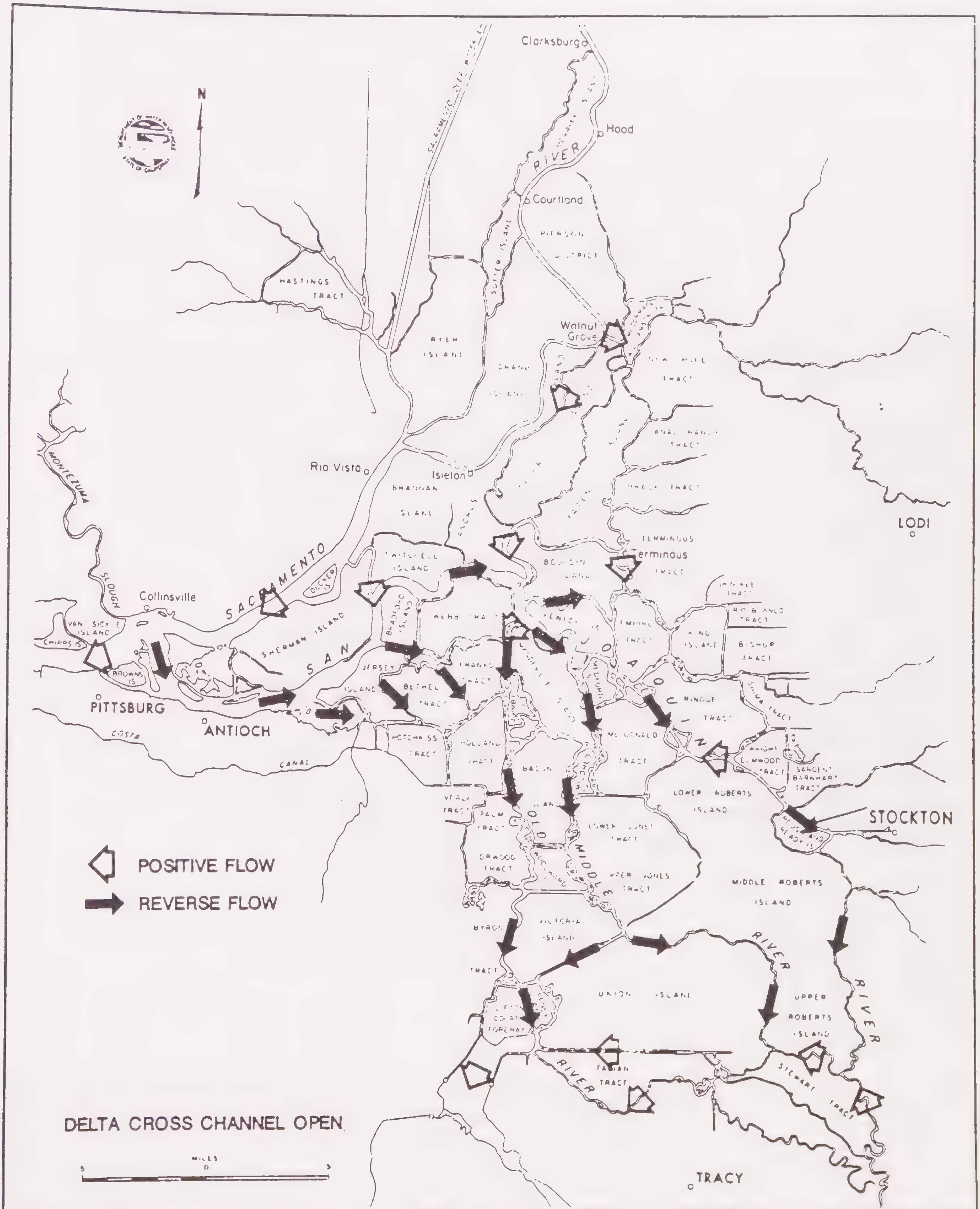


Figure 2. Delta Flow Patterns Under Low Flow Conditions and High Export (California Department of Water Resources)

The proportion of Sacramento River flow drawn into the DCC under alternative operations is compared to the proportion drawn into the DCC under existing conditions. DCC flow is estimated from Sacramento River flow at Sacramento (California Department of Water Resources 1989a). Operation of the Delta Cross Channel Gates is based on the California State Water Resources Control Board Water Rights Decision 1485. Detailed evaluation of the effect of changes in salmon populations in terms of the proportion of Sacramento River water entering the central Delta via the DCC is discussed in the "Species-Specific Impact Assessment Methodologies" section for chinook salmon.

The net flow in the lower San Joaquin River under each alternative is compared to the net flow under existing conditions. The proportion of inflow to the lower San Joaquin River that is diverted is also determined.

Diversions. Diversions (including export) are a primary factor influencing Delta flow patterns. In addition, diversions entrain Delta fish, primarily eggs, larvae, and juveniles. Higher diversions entrain more fish, however, and the number entrained relative to the volume of water diverted is dependent on both physical and biological factors. Physical factors include depth, volume (relative to the source water), turbidity, and location of the diversion. Biological factors include fish density and vulnerability to entrainment, where such vulnerability is dependent on fish size, shape, swimming ability, condition, and behavior.

Historic salvage (1981-1988) at the SWP and CVP fish protection facilities indicates the timing of species vulnerability to entrainment (Figure 3). Species with life stages that are not effectively salvaged at the fish protection facilities are probably entrained in greater numbers before the peak entrainment indicated by salvage records. For example, striped bass salvage typically peaks during June and July, but substantially more individuals are entrained during April and May as eggs and larvae (Figure 4) (California Department of Fish and Game 1987c, Spaar 1990). Entrainment of Delta smelt, Sacramento splittail, and longfin smelt probably shows a similar pattern, with considerably more individuals entrained earlier as larvae than has been indicated by the salvage data.

For most species, entrapment effects are evaluated based on temporal and spatial distribution of fish species and changes in diversion timing and volume. Detailed evaluation of salmon and striped bass entrainment is discussed in the "Species-Specific Impact Assessment Methodologies" section.

San Francisco Bay

Implementation of various project operations could alter the timing and volume of Delta outflow. Delta outflow can influence the abundance and distribution of fish and invertebrates in the Bay, but the response of organisms to outflow is species- and life-stage dependent. Fish populations may be affected by changes in migration opportunities, habitat availability, and concentration of toxic substances (California Department of Fish and Game 1987b, Herrgesell 1990).

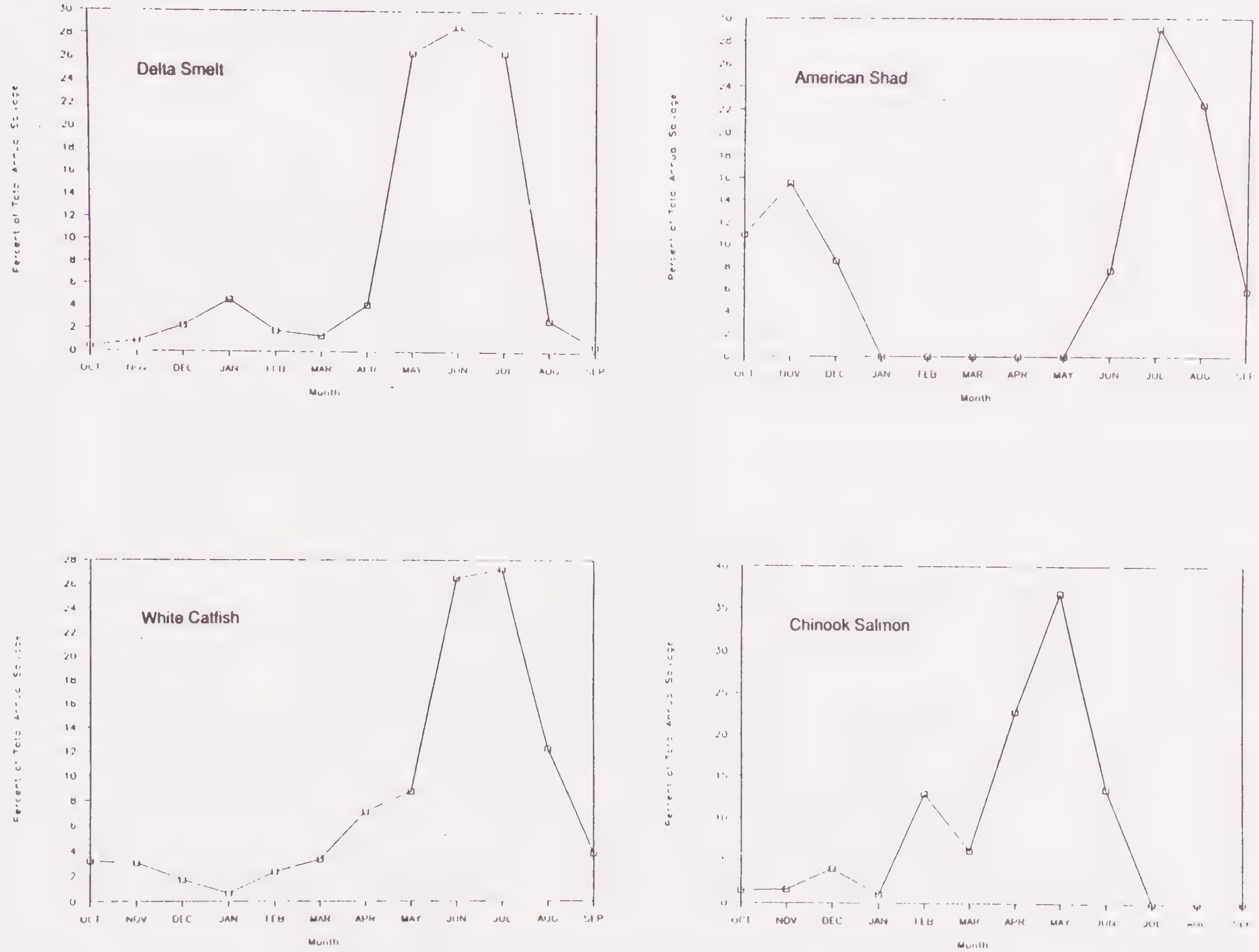


Figure 3. Historic Salvage of Four Species at the SWP Fish Protection Facility

Figure 4. Salvage and Entrainment of Striped Bass at Clifton Court Forebay

Three general parameters that are affected by Delta outflow and may affect abundance and distribution of some Bay species are salinity, direct transport by currents, and nutrient levels. The effects of outflow on physical, chemical, and biological conditions are greatest in Suisun Bay, less pronounced in San Pablo Bay, and the least severe at the mouth of the Bay near the Golden Gate Bridge.

Output of riverine phytoplankton to the Bay and primary productivity in the Bay may be important factors affecting food availability for Bay/Delta species. Production and availability of phytoplankton may be partially determined by the level of Delta outflow; however, the mechanisms regulating the level of phytoplankton production (i.e., location of the entrapment zone [Figure 5]) are not fully understood.

Delta outflow under alternative water project operations is compared to outflow under existing conditions. Although changes in Delta outflow affect the abundance and distribution of fish species, the significance of outflow changes, relative to overall Bay productivity and changes in species populations, cannot be determined with available data.

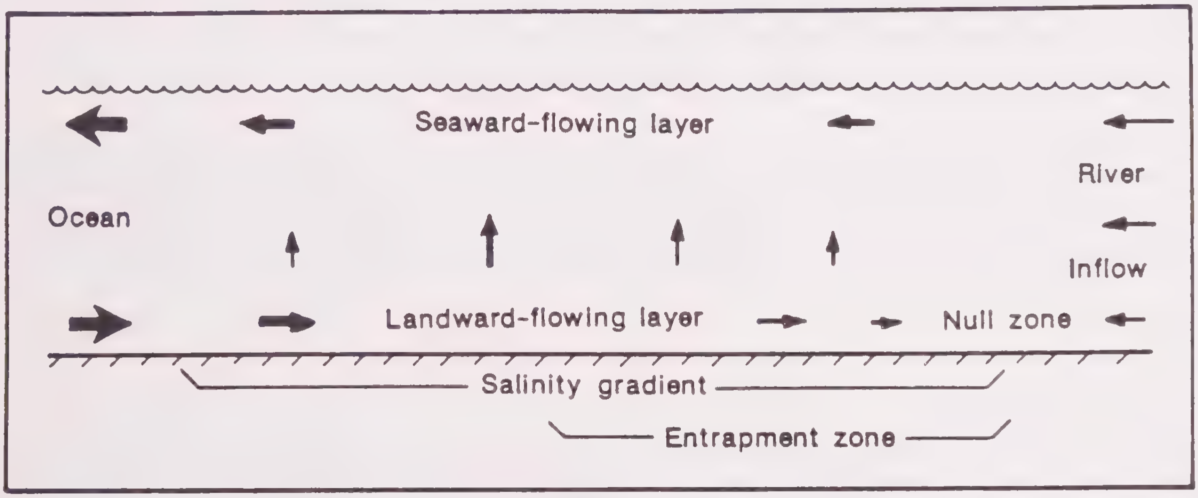
Rivers

Changes in the timing and volume of diversions from the Delta relative to existing conditions could alter reservoir release patterns to provide Delta inflow sufficient to maintain Delta water quality and outflow standards (California State Water Resources Control Board 1978b). Flow rates and water temperature could be affected in the American, Feather, Sacramento, San Joaquin, and Trinity Rivers.

Flow. Flow volume affects the availability of spawning and rearing habitat (especially for chinook salmon and steelhead trout), attraction flows for upstream migration of adult fish to spawning areas (chinook salmon and American shad), and flushing flows for downstream carriage and migration of eggs, larvae, and juvenile fish (including chinook salmon, striped bass, white sturgeon, and American shad). Changes in habitat availability or migration opportunity can affect fish survival, growth, and reproduction. Average monthly discharge under alternative operations is compared to discharge under existing conditions. The monthly change in flow under alternative operations is also compared to change in flow under existing conditions.

Temperature. Survival and growth of chinook salmon and steelhead trout during the spawning and rearing life stages are dependent on the suitability of temperatures in the riverine habitat. Dams block the upstream migration of salmonids to historic year-round cool-water habitat and limit cool-water habitat to reaches immediately below major reservoirs.

The Sacramento River supports four runs of chinook salmon (fall, late fall, winter, and spring), the Trinity River supports two runs (fall and spring), and the American River supports only a fall run. The temporal and spatial distribution of the runs determines the effects of water temperature on survival. The most temperature-sensitive life stage is egg



Notes: Width of arrow indicates intensity of flow.

Null zone is where net vertical velocity is near zero and horizontal velocity near bottom is equal on incoming (flood) and outgoing (ebb) tides.

Entrapment zone lies between null zone and area of maximum vertical velocity in water column.

Salinity gradient is area of increasing surface salinity seaward of null zone.

Figure 5. Location of the Null Zone, Entrapment Zone, and Salinity Gradient in a Stylized, Two-Layered Estuary

incubation. Winter-, spring-, and fall-run eggs incubate through summer and early fall when water temperature is likely to exceed 57°F for extended periods in spawning areas.

Both reservoir storage and riverflow volume affect the water temperature below Clair Engle, Shasta, and Folsom Reservoirs on the Trinity, Sacramento, and American Rivers, respectively. Water temperature in the Sacramento River below Keswick is largely controlled by storage in Shasta Reservoir (i.e., reduced storage diminishes the availability of cool water for release to the Sacramento River) (Figure 6). Reduced discharge may exacerbate elevated temperature conditions, especially with increasing distance downstream from Keswick Dam to Red Bluff. The Trinity and American Rivers are similarly affected by Clair Engle and Folsom Reservoirs. The primary months that temperature is a concern are May or June through October.

Reservoir storage and flow volume under alternative operations are compared to storage and discharge under existing conditions. Storage and discharge reductions initiate conditions that could increase temperatures. The months and years over which storage and discharge decline substantially are identified.

Upstream Reservoirs

Water releases from four major reservoirs (Clair Engle, Shasta, Folsom, and Oroville) are an integral part of maintaining required Delta water quality and outflow standards. Changes in Delta diversion timing and volume may require that changes be made in the timing and volume of releases from Clair Engle, Shasta, Oroville, and Folsom Reservoirs. Altered reservoir releases affect reservoir storage, which is directly related to reservoir water surface elevation and area.

Changes in water surface area and elevation affect fish productivity in reservoirs. In general, reservoirs are more productive when the maximum surface area is maintained. Reservoir water surface elevation affects both the availability of spawning and rearing habitat and spawning success of centrarchids and catfish. Declining reservoir elevation can cause adult fish guarding nests to flee, disrupt spawning activities, dewater fish nests, and strand fish.

End-of-month reservoir elevations are used to evaluate impacts on reservoir species, primarily centrarchids (largemouth bass, smallmouth bass, and sunfish). Reservoir elevations under alternative operations are compared to reservoir elevations under existing conditions. Monthly change in water surface elevation under alternative operations is also compared to change under existing conditions.

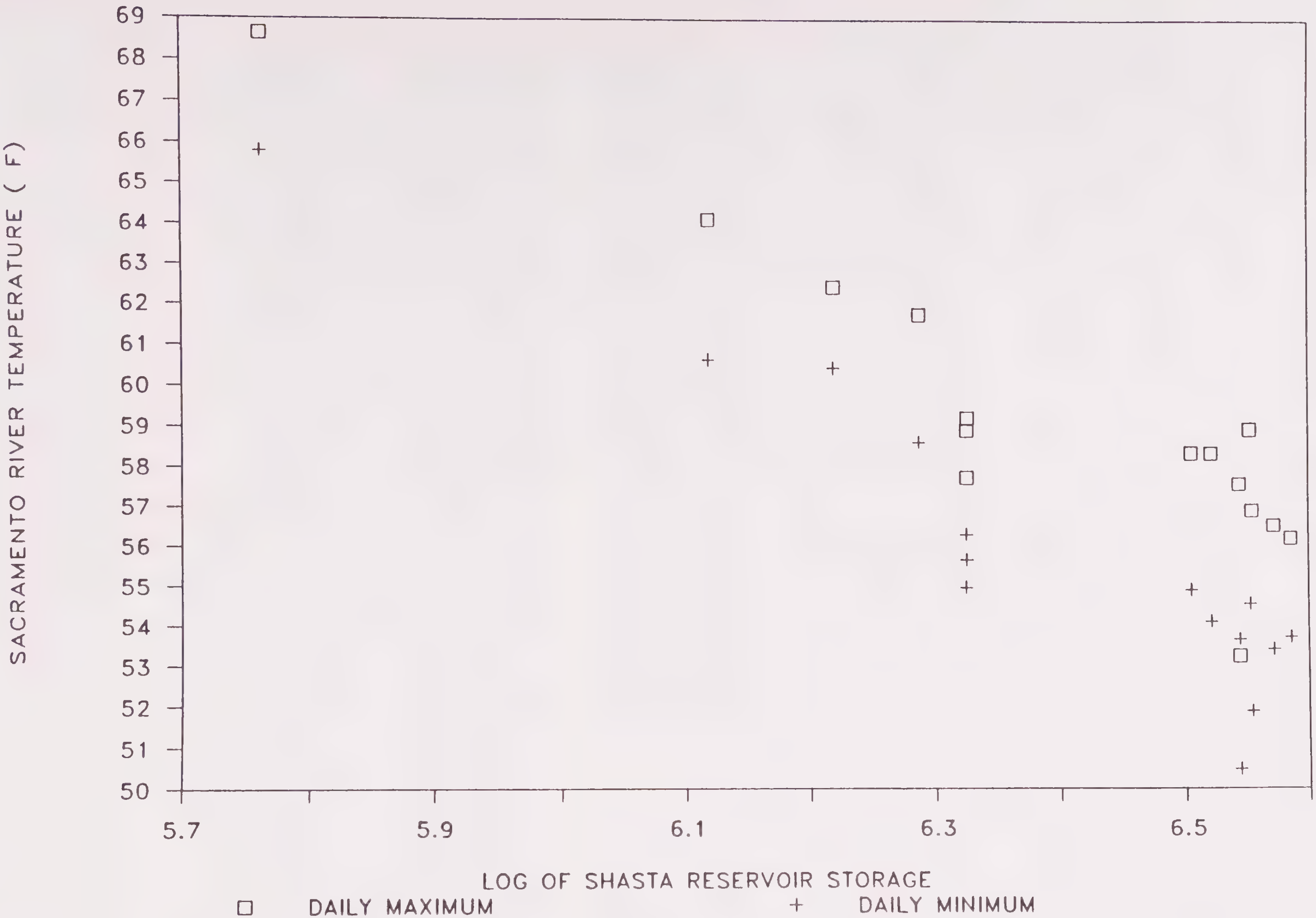


Figure 6. Shasta Reservoir Temperatures and Sacramento River Temperature at Bend Bridge for August

SPECIES-SPECIFIC IMPACT ASSESSMENT METHODOLOGIES

Chinook Salmon

Delta Migration Mortality Model

Chinook salmon survival during smolt migration through the Delta appears to be correlated with, and may be dependent on water temperature, fraction of water diverted at Walnut Grove, and SWP and CVP export (Kjelson et al. 1989a). The model developed by Kjelson et al. (1989a) was developed to evaluate the effect of alternative operations on chinook salmon mortality during April, May, and June (Table 2). The model is applied to all months of salmon smolt migration (i.e., October through June). The accuracy of the estimated mortality rates are assumed sufficient for assessment of the impacts of alternative operations. The minimum water temperature is set at 59°F. The fraction of water diverted at Walnut Grove is estimated using relationships developed by the California Department of Water Resources (1989a) and U.S. Fish and Wildlife Service (1987) or was output from either the RMA or Fischer Delta model.

Entrainment Loss Index Model

Entrainment loss estimates are not intended to express a specified degree of accuracy; instead, they are an index of entrainment loss for use in evaluating impacts under alternative operations. Changes in entrainment loss from existing conditions, however, generally represent the magnitude of changes to be expected.

Entrainment loss of chinook salmon at SWP and CVP intakes is dependent on screen efficiency, predation, and movement of fish into the influence of the diversions. Sacramento River salmon would move into the influence of the diversion only if they are drawn into the central Delta via the DCC and Georgiana Slough and, if central and south Delta diversions (SWP, CVP, and others) are sufficient to affect the path of migration. The survival of salmon migrating through the central Delta appears to be partially affected by the volume of export (Kjelson et al. 1989a). The relationship between export volume and survival is part of the methodology used to evaluate differences in entrainment between no-project and alternative operations.

Base Population Determination. The estimated chinook salmon population vulnerable to entrainment loss is based on the following assumptions.

- All salmon originate from the Sacramento River. The effect of the additional central and south Delta diversion on chinook salmon from the San Joaquin system is assumed small because existing SWP and CVP export would entrain outmigrant chinook salmon from the San Joaquin River regardless of the incremental increase in export.

Table 2. Equations for Calculating Fall-Run Chinook Salmon Mortality during Migration through the Delta

Step 1. Calculate mortality for the Sacramento River between Sacramento and Walnut Grove

$$M1 = -2.858 + (0.04851 * \text{Temperature})$$

Note: Water temperature is measured at Freeport in degrees Fahrenheit.

Step 2. Calculate mortality between Walnut Grove and Chipps Island via the Delta Cross Channel and Georgiana Slough

$$M2 = -0.5809 + (0.01793 * \text{Temperature}) + (0.0000418 * \text{Export})$$

Note: Export is the total monthly export for the CVP and SWP in cubic feet per second.

Step 3. Calculate mortality between Walnut Grove and Chipps Island via the Sacramento River

$$M3 = -1.766 + (0.03489 * \text{Temperature})$$

Step 4. Calculate total monthly mortalities

$$\text{Monthly Mortality} = M1 + [(M2 * DCC) + (M3 * [1 - DCC]) - [M1 * ([M2 * DCC] + [M3 * (1 - DCC)])]$$

Note: DCC is the proportion of Sacramento River discharge (at the DCC) drawn through the Delta Cross Channel and Georgiana Slough.

Step 5. Calculate total annual mortality

$$\text{Annual Mortality} = [(\text{April} * 15) + (\text{May} * 55) + (\text{June} * 30)]/100$$

Note: April, May, and June terms represent the monthly mortalities for April, May, and June. The values 15, 55, and 30 are the percent of the fall-run smolt population migrating through the Delta during April, May, and June, respectively.

Source: Kjelson et al. 1989a.

- The average number of chinook salmon entrained per thousand acre-feet (TAF) of export at the SWP pumps during 1981-1988 is representative of the distribution and magnitude of the number of fish exposed to future entrainment at the SWP and CVP diversions. Entrainment attributable to export is overestimated because SWP salvage includes an unknown but substantial number of salmon originating from the San Joaquin River that probably would be minimally affected by the incremental increase in diversion under alternative operations.

- The number of salmon entrained at the SWP fish protection facility is calculated for an extreme condition (i.e., screening efficiency is 70% and presalvage loss to predation and adverse conditions is 75%) (California Department of Fish and Game 1987g).

- The proportion of chinook salmon recovered at the SWP fish protection facility after release of tagged fish above the Delta Cross Channel in April 1988, 0.42% (Kjelson et al. 1989b), is a reasonable estimate of the proportion of salmon that would be salvaged under similar environmental conditions and salmon densities in the Delta.

Salvage numbers for the SWP fish protection facility (1981-1988) are converted to the number of fish exposed to the screens by dividing by efficiency. Efficiency is the probability that a fish will be salvaged. Assuming an extreme condition, an efficiency of 0.70 is used (California Department of Fish and Game 1987g). The number of fish exposed to the screens is converted to the number of fish exposed to entrainment by dividing by one minus the predation rate. A predation rate of 75% is used based on California Department of Fish and Game studies (1987g). Values for each month are averaged for the 1981-1988 period (Table 3).

The number of salmon entrained, N_f, is converted to the number of salmon drawn into the DCC and Georgiana Slough by:

$$N_a = N_f \times -\ln(1-A) / (F \times A)$$

N_a is the number of salmon drawn into the DCC and Georgiana Slough, F is the entrainment mortality rate, and A is the total mortality rate for fish drawn into the DCC and Georgiana Slough (equation derived from Ricker 1975).

Total monthly mortality, A, is calculated using the relationship between mortality, temperature, and export developed by Kjelson et al. 1989a. The equation is assumed applicable to all months and all runs:

$$A = -0.5809 + (0.01793 \times T) + (0.0000418 \times \text{Export})$$

T is average monthly water temperature in °F for the Sacramento River at Freeport for 1962-1988 (Table 3). The minimum value for T is set at 59°F. Export is the average monthly volume pumped (in cfs) via the CCWD, SWP, and CVP pumps for 1981-1988 (California Department of Water Resources 1989a).

Table 3. Average Monthly Chinook Salmon Salvage per 1,000 af at the SWP Fish Protection Facility (1981-1988) and Average Monthly Water Temperature on the Sacramento River at Freeport (1962-1988)

Parameter	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Chinook salmon salvage												
Winter run	0	0	2	1	5	17	23	2	0	0	0	0
All runs	14	14	49	11	35	82	280	358	178	0	0	0
Temperature (°F)	62	54	49	47	49	53	57	64	69	71	71	68

Instantaneous entrainment mortality, F, is calculated for April 1988 by the following equation:

$$F = U \times A / Z$$

A is the total monthly mortality calculated for April 1988 using the methods described above (total export rate is 8,750 cfs and the average temperature for April is 57°F), Z is the total instantaneous mortality rate and is equal to -ln(1-A), and U is the proportion of fish entrained. The proportion entrained in April 1988 is 0.0320 and is the proportion of fish released above the Delta Cross Channel during April 1988 that were ultimately recovered at the SWP fish protection facility.

$$U = 0.0042 / (0.70 \times 0.25 \times 0.75) = 0.0320$$

The proportion salvaged for April 1988 is 0.0042, 0.70 is the assumed screen efficiency, 0.25 is 1 minus the assumed predation rate (0.75), and 0.75 is the proportion of Sacramento River flow (immediately above the Delta Cross Channel) drawn into the Delta Cross Channel and Georgiana Slough. From U and A (0.7154), F is estimated to be 0.0562 during April 1988.

Export volume and temperature likely affect F and U. The instantaneous entrainment mortality for other months and years is calculated by:

$$F = 0.0562 \times [\{X/(X + Y)\}/Z\,]^2$$

where 0.0562 is F for April 1988, X is 0.0000418 times export (from the equation for A), Y is 0.01793 times temperature in °F, and Z is the value of X/(X + Y) for April 1988 (total export is 8,750 cfs and temperature is 57°F).

Estimated F values are not accurate, but the change in F values and the entrainment rate (U) with change in export and temperature is as expected (i.e., the proportion entrained would be greatest at low temperatures and high export) (Figure 7). The adjustment of F allows changes in entrainment under variable export and temperature conditions in the Delta to be compared.

The number of salmon drawn into the DCC and Georgiana Slough (N_a) is converted to N, the number of salmon migrating down the Sacramento River, by dividing by the average monthly proportion of Sacramento River discharge at Sacramento drawn into the DCC and Georgiana Slough during 1981-1988. The median of N for all years (1981-1988) is the base population, N_b, and is used to calculate entrainment by central and south Delta diversions during the simulated years (1922-1978). A base population, N_b, is determined for all runs combined and for the winter run.

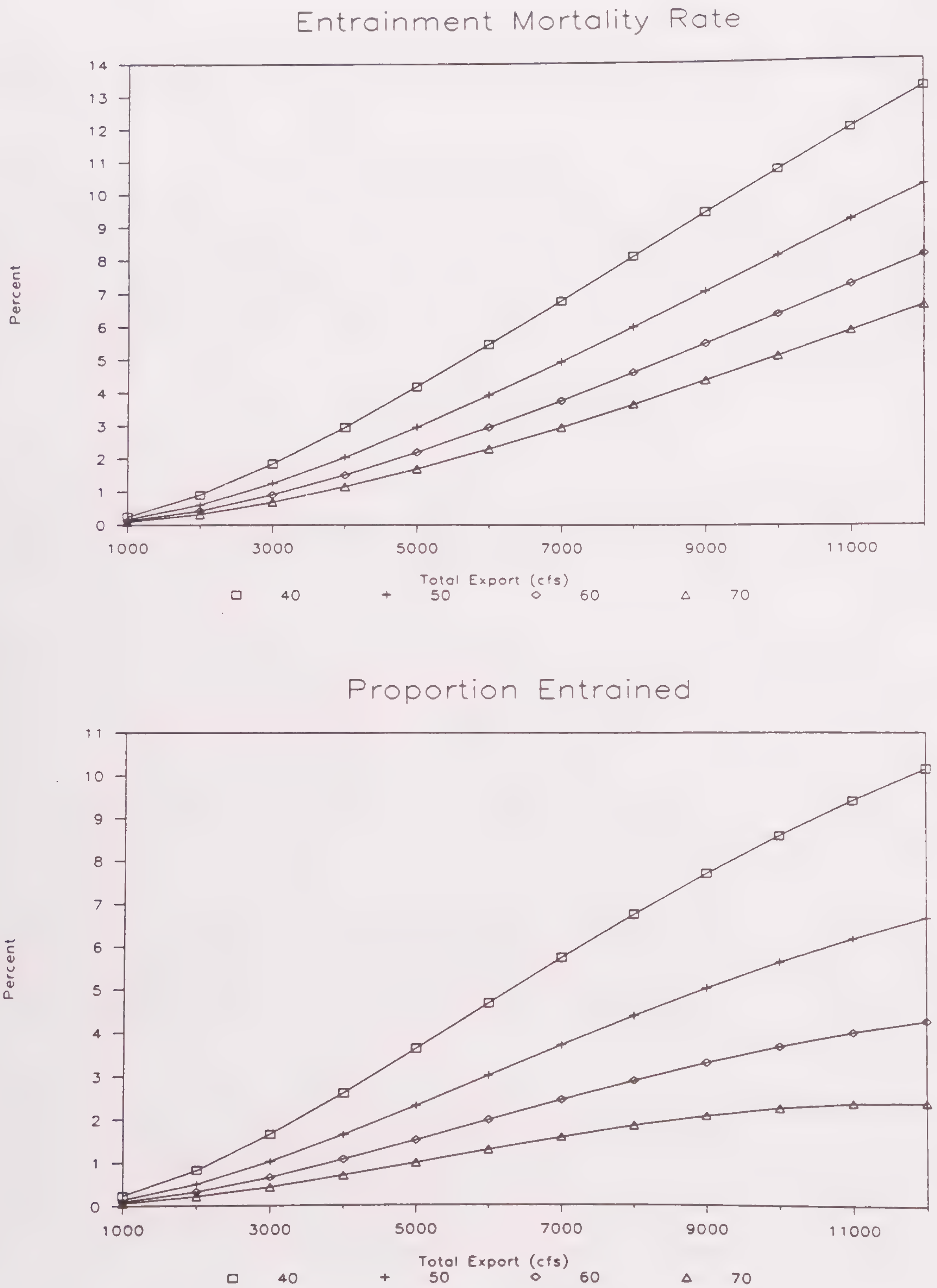


Figure 7. Estimated Chinook Salmon Entrainment Mortality Rate and Proportion Entrained for Various Levels of Export (CCWD,SWP, and CVP) and Temperatures (40, 50, 60, and 70 degrees Fahrenheit)

Estimated Entrainment. The number of chinook salmon entrained by central and south Delta diversions each month, N_f, is calculated by:

$$N_f = N_b \times P \times F \times A / -\ln(1-A)$$

P is the proportion of the Sacramento River flow drawn into the DCC and Georgiana Slough (from the simulations under the operation alternatives, 1922-1978). N_b is the base population calculated in the previous section. F and A are calculated as described in the previous section using average monthly temperature for the Sacramento River at Freeport and total central and south Delta diversions from the simulations under the operation alternatives (1922-1978).

Estimated Salvage. Salvage, S, is estimated from entrainment, N_f. Entrainment at each diversion is assumed proportional to the volume pumped. Predation and salvage efficiency are assumed equal for SWP and CVP intakes.

$$S = N_f \times S_1$$

S_1 is the salvage rate at the CVP and SWP pumps (i.e., the proportion of total pumping via the CVP and SWP times survival of predation [0.25] times salvage efficiency [0.70]).

Estimated Entrainment Loss. Estimated entrainment loss is total entrainment (N_f) minus total salvage (S). Entrainment loss is for total central and south Delta diversion. Changes in entrainment loss between existing conditions and alternative operations are losses attributable to the alternatives.

Habitat-Discharge Models

If river discharge for an alternative is substantially different than discharge under existing conditions, habitat-discharge models or other methodologies will be used to further evaluate the effects of flow changes on chinook salmon.

For the American River, spawning and rearing indices were developed for flow from the results of instream flow studies (U.S. Fish and Wildlife Service 1985b, Kelley et al. 1985) and their applications (Jones & Stokes Associates 1989a) (Table 4). The results of ongoing studies may be used to improve the indices, but information is currently unavailable. The spawning index is based on the estimated spawning area available in the American River upstream of Ancil Hoffman Park and the proportion of the run spawning in each section of river. A spawning index value is assigned to each mean monthly discharge for September through January and weighted by the monthly proportion of the population spawning. The monthly proportion of the population spawning during September through January is 0.03, 0.16, 0.63, 0.15, and 0.02, respectively. The weighted spawning indices for September-January are totaled for each year (1922-1978), and the annual spawning indices for alternative operations are compared to the annual spawning indices for existing conditions.

Table 4. Spawning and Rearing Indices for Chinook Salmon in the American River

Discharge (cfs)	Spawning Index	Rearing Indices	
		<50 mm	>50 mm
300	0.23	1.00	0.5
500	0.44	0.89	0.9
750	0.60	0.80	1.0
1,000	0.87	0.64	1.0
1,250	0.93	0.54	0.9
1,500	0.97	0.49	0.8
1,750	1.00	0.44	0.7
2,000	0.98	0.39	0.6
2,250	0.94	0.35	0.5
2,500	0.88	0.32	0.5
3,000	0.72	0.29	0.4

The 50 millimeter (mm) rearing index is based on the relationship between rearing habitat and flow (U.S. Fish and Wildlife Service 1985b). The >50-mm rearing index is also based on the USFWS (1985b) habitat flow relationship, but habitat values are adjusted to higher flows as indicated by later studies (Kelley et al. 1985). A 50-mm rearing index value is assigned to each mean monthly discharge for January-March and a >50-mm rearing index value is assigned to mean monthly discharge for April-June. The index values are weighted for January through June by multiplying by 0.2, 0.8, 1.0, 1.0, 1.0, and 0.5, respectively. The weighted index values are totaled for each year and divided by 4.5 to obtain the annual rearing index. The annual rearing indices for the alternative operations are compared to the annual rearing indices for existing conditions.

As an alternative to habitat-discharge relationships on the Sacramento River, which are currently unavailable, critical flow exceedance will be compared for operations under different operation alternatives. Critical flow for the Sacramento River has been identified as 6,000 cubic feet per second (cfs) (U.S. Fish and Wildlife Service and California Department of Fish and Game 1987). Increased frequency of flows less than 6,000 cfs may reduce the availability and quality of chinook salmon spawning and rearing habitat.

Also, redd dewatering and stranding have been identified as factors affecting chinook salmon survival in the Sacramento River. At discharges less than 6,000 cfs, the frequency and magnitude of monthly reductions in discharge are evaluated.

Temperature Models

If reservoir storage and river discharge change substantially and temperature modeling is needed, changes in temperature attributable to alternative operations will be evaluated in detail.

General Temperature Analysis. Temperature under each alternative will be compared to temperature under existing conditions. Months and years that temperatures exceed 57°F and 60°F, the presumed critical spawning and rearing temperatures for chinook salmon, will be identified and the effects on the population evaluated.

Temperature-Related Mortality. For chinook salmon, changes in population abundance relative to the no-project condition will be evaluated with a monthly temperature-survival model. The temperature model was developed for previous impact assessments (Jones & Stokes Associates 1989a) and considers the affect of temperature on the survival of chinook salmon from fertilization through out-migration.

The model uses simulated monthly temperature and calculates development rate, survival during development, and survival during rearing. The survival of the proportion of the run spawned during a month is determined by multiplying the proportional abundance by the appropriate development and rearing survival rates over the period of riverine life. The surviving proportions of the year class for all months of spawning are added to obtain a survival index.

A survival index of 1.00 indicates that temperature is not a factor in mortality of a year class, and a survival index of 0.00 indicates that death of the entire year class results from temperature-caused mortality. Survival under each alternative will be compared to survival under existing conditions.

Winter-Run Chinook Salmon

The Delta Migration Mortality Model and the Entrainment Loss Index Model presented in the previous section, "Chinook Salmon", will be used to assess the impacts of Delta Wetlands Project operations on winter-run chinook salmon that migrate through the Delta as smolt. Although migration of winter-run smolt generally occurs outside the period for which the Delta Migration Mortality Model was developed, the accuracy of the estimated mortality rates and entrainment rates are assumed sufficient for assessment of impacts of alternative operations.

Striped Bass

As with chinook salmon, entrainment loss estimates and the 38-mm abundance index are not intended to express a specified degree of accuracy and are indices for use in evaluating impacts under alternative operations. Changes in entrainment loss from the No-Action Alternative, however, may represent the magnitude of changes to be expected.

Striped bass entrainment loss is calculated in two parts, fish <38 mm in length and fish >38 mm in length. Striped bass eggs and larvae <38 mm are carried and dispersed by the riverine and estuarine currents. Bass greater than 38 mm in length are assumed to actively control their movements, and net flow direction is less likely to be a primary factor controlling destination.

Survival Rate Model

If survival of striped bass eggs and larvae moving into Suisun Bay is higher than for eggs and larvae retained in the Delta, the annual survival of striped bass from 9 mm to 38 mm should reflect Delta flow conditions. The survival of striped bass from 9 mm to 38 mm in length correlates with Delta export and outflow levels during May and June (Herrgesell 1990). Export and outflow are indicative of the flow conditions in the Delta.

A better measure of the retention of striped bass eggs and larvae in the Delta may be the proportion of flow diverted, especially the proportion diverted off the Delta east of the Sacramento River. The Delta diversion index is a measure of the proportion of inflow diverted from the Delta east of the Sacramento River.

$$\text{Delta Diversion Index} = [E + (0.65 \times A)]/[I + DCC + (0.65 \times P)]$$

where E is export, including diversions by CVP, SWP, and CCWD; A is total Delta consumptive use; I is inflow from east Delta tributaries, including the San Joaquin, Mokelumne, and Cosumnes Rivers; DCC is flow in the Delta Cross Channel and Georgiana Slough; and P is total Delta precipitation. A and P are multiplied by 0.65, the estimated proportion of Delta diversions and precipitation east of the Sacramento River.

(Note: Depending on the availability of information, the Delta diversion index may be estimated by:

$$\text{Delta Diversion Index} = [E + (0.65 \times D)]/[TI - Sac + DCC]$$

where E and DCC are the same as above, D is net channel depletion, TI is total Delta inflow, and Sac is Sacramento River inflow to the Delta.)

The estimated survival of striped bass from 9 mm to 38 mm in length was regressed on the average April-June Delta diversion index for the corresponding years (1968, 1970-1973, 1975, 1984-1986, and 1988-1990). The correlation is significant, with a correlation coefficient of 0.86 (Figure 8). The regression equation is:

$$\text{Survival} = 0.0019 - (0.0013 \times \text{Delta Diversion Index})$$

To estimate average April-June survival for each year of the 57-year simulation, the equation is modified (0.0025 is used in place of 0.0019) so that survival is always greater than 0 and all years can be compared. In addition, the modified equation is used to estimate survival for individual months (i.e., April through July). Estimated survival for existing conditions is compared to estimated survival under alternative operations.

38-mm Survival Index Model

Eggs and Larvae to 38 mm in Length. Many factors affect the distribution of striped bass eggs and larvae within the estuary, including salinity, temperature, Delta inflow and outflow, Sacramento River conditions, and flow patterns in the Delta. Relationships between physical and biological factors controlling striped bass distribution are complex, and the evaluation of water project operations on fish distribution focuses on factors that are clearly influenced by the projects and appear to affect the distribution and survival of striped bass eggs and larvae.

The impacts of Delta diversions on fish populations have generally been assessed based on the assumption of a constant density of larvae per acre-foot (af) based on historical average density (California Department of Water Resources 1990b, 1990c). The use of historical average density may be adequate for estimating entrainment of species or life stages whose distribution is relatively unaffected by Delta flow patterns. The distribution of striped bass eggs and larvae, however, is substantially affected by Delta flow patterns and the change in those patterns over time.

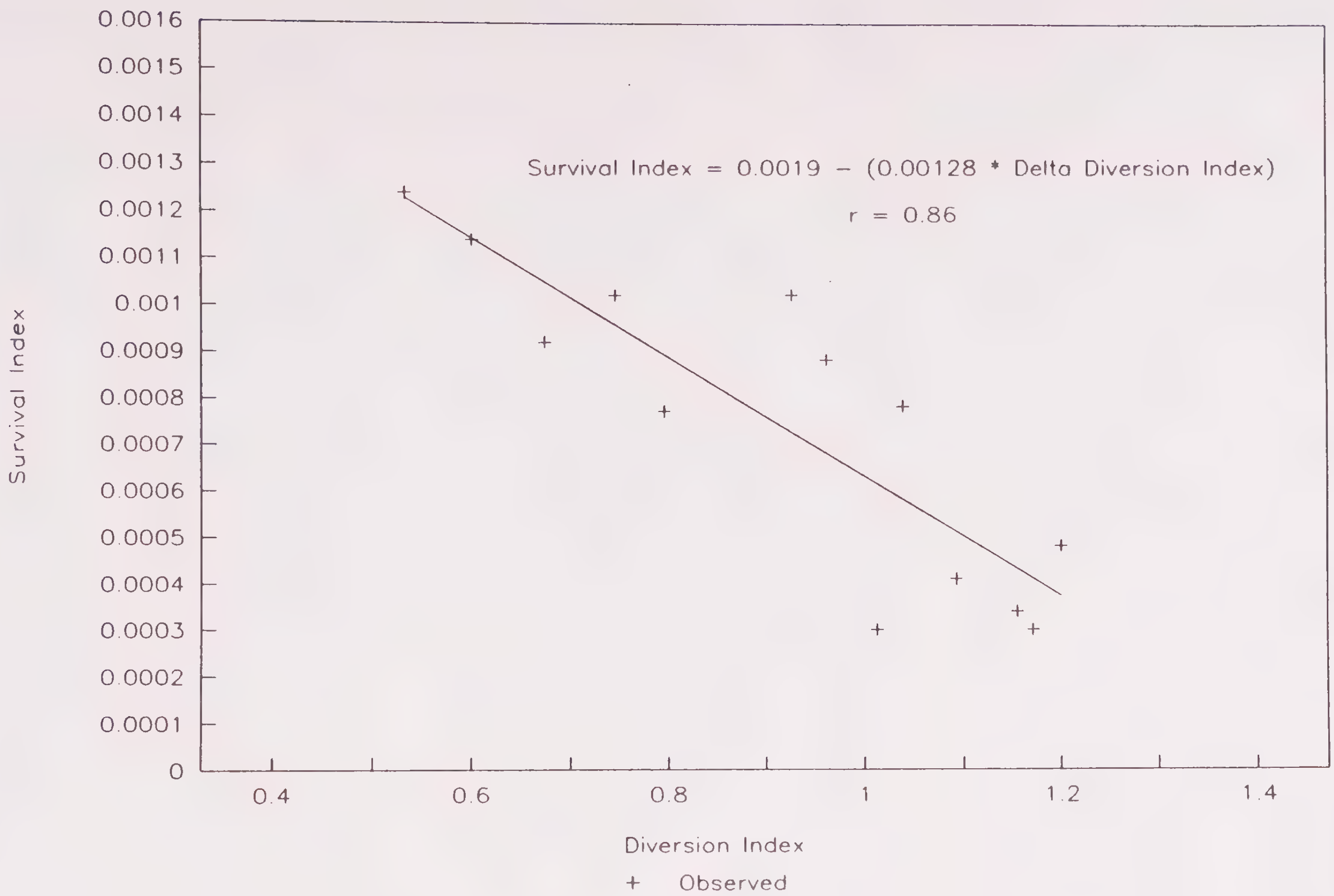


Figure 8. Regression of Striped Bass Survival from 9mm to 38mm on the Average April – June Delta Diversion Index

Wendt (1987) showed that the level of salvage loss during at least June and July is partially determined by the volume of export and net flow in the lower San Joaquin River. The density of fish vulnerable to entrainment and the number of fish entrained are dependent on flow patterns throughout the egg and larval period (i.e., April through July).

A model was developed to estimate the direct and, to some extent, the indirect losses of striped bass eggs and larvae (<38 mm) to entrainment in diversions from the Delta. The estimated entrainment loss may represent the magnitude of loss that would be expected under actual conditions; however, the purpose of the model is to calculate differences in entrainment loss and 38 mm abundance indices between alternative operations for a given year.

The following assumptions are made:

- natural mortality is the same for all years and during all time periods and is dependent on size;
- growth from egg to 38 mm juvenile requires 90 days regardless of time of initial fertilization;
- total egg production for the population is 200 billion every year;
- the survival rate of fish from 38 mm to yearling equivalents is 2.61% for July and 2.77% for August (Chee pers. comm.);
- eggs originating in the Sacramento River are not subject to entrainment loss unless the larvae enter the lower San Joaquin River via the Delta Cross Channel, Georgiana Slough, Threemile Slough, or the lower San Joaquin River around Sherman Island;
- the difference between the natural survival rate (constant) and the striped bass survival rate calculated for the modeled hydrologic conditions (as described under "Survival Index Model") is attributable to changes in Delta diversions and flow patterns; and
- the number of larvae per unit volume moving out of the lower San Joaquin River and away from possible entrainment in diversions is equal to the number of larvae per unit volume entrained in diversions.

Egg Distribution. Egg distribution is a function of the timing and location of spawning and Delta flow patterns. Of the eggs spawned in the Sacramento River, only those individuals entering the lower San Joaquin River are potentially entrained by diversions east of the Sacramento River. Individuals in the San Joaquin River, whether they were spawned in the lower San Joaquin River or are carried by currents from the Sacramento River, leave only via diversions or net Delta outflow.

Striped bass spawning in the lower San Joaquin River are assumed to produce 40% of the annual egg production, 20% during late April and 20% during early May. About 60% of the annual egg production originates in the Sacramento River upstream of the Delta. Egg production in the Sacramento River is assumed to occur in three phases, with 24% spawned on May 1, 24% spawned on May 15, and 12% spawned on June 1.

The time required for eggs spawned in the Sacramento River to reach either the lower Sacramento River or the lower San Joaquin River is assumed to be 15 days. Survival during movement down the Sacramento River is equal to the natural survival rate for the first 15 days after fertilization (Table 5).

The number of striped bass larvae moving into the lower San Joaquin River via the DCC and Georgiana Slough is proportional to the amount of Sacramento River water diverted. The remainder move into the lower Sacramento River.

Entrainment. The entrainment rate of eggs and larvae in diversions east of the Sacramento River is estimated by:

$$ER = (\ln S - \ln 0.0025) / 6$$

where ER is entrainment rate, S is the survival rate from the survival index model, and 0.0025 is the assumed maximum natural survival rate from egg to 38 mm length. The entrainment rate is divided into equal parts for the six 15-day periods of development. An entrainment rate is calculated for each month of each year and is assumed equal for each 15-day period in the same month.

Entrainment is determined by the relationship between total survival and the entrainment rate. Survival in the lower San Joaquin River for a 15-day period is calculated by:

$$S_{15} = e^{[ER \times (1 + SJOUT)] - R15}$$

where ER is the entrainment rate from above and R15 is the natural log of the survival rate from Table 5. SJOUT is the ratio of outflow from the lower San Joaquin River to total diversions from the Delta east of the Sacramento River relative to the Delta Diversion Index (i.e., CVP, SWP, and CCWD diversion plus 65% of total Delta consumptive use). SJOUT is equal to 1 minus the Delta Diversion Index divided by the Delta Diversion Index.

In the Sacramento River, survival for a 15-day period is calculated by:

$$S_{15} = e^{[ER \times (FSJ + SACOUT + DIV)] - R15}$$

where ER and R15 are the same as above. FSJ is the ratio of Sacramento River flow into the San Joaquin River via Threemile Slough and past Antioch to net inflow from the Sacramento River (i.e., Sacramento River flow and 35% Delta precipitation minus DCC and Georgiana Slough flow). SACOUT is the ratio of outflow from the lower Sacramento River to net inflow from the Sacramento River. DIV is the ratio of diversion from the

Table 5. Estimated Survival Rates for Striped Bass from Eggs to 38 mm in 15-Day Increments

Period from Fertilization (Days)	Natural Log of Survival Rate	Survival Rate (%)
1-15	-3.49	3
16-30	-0.91	40
31-45	-0.58	56
46-60	-0.50	61
61-75	-0.31	72
76-90	-0.21	81
1-90	-5.99	0.25

Sacramento River portion of the Delta (35% of total Delta consumptive use) to net inflow from the Sacramento River. FSJ, SACOUT, and DIV are divided by 0.75 to adjust for the smaller static volume of the Sacramento River relative to the lower San Joaquin River.

For example:

$$FSJ = [(SACSJ / SACNET) \times (SACNET / SJIN)] / DDI / 0.75$$

where SACSJ is Sacramento River flow into the San Joaquin River via Threemile Slough and past Antioch, SACNET is net inflow into the lower Sacramento River, SJIN is inflow to the lower San Joaquin River (not including reverse flow), DDI is the Delta Diversion Index defined previously, and 0.75 is the adjustment for the smaller static volume of the Sacramento River relative to the volume of the lower San Joaquin River.

Entrainment loss of eggs and larvae for each 15-day period is calculated by:

$$ELOSS = N \times ER \times (1 - S_{15}) / \ln S_{15} \times S_{nat}$$

where N is the number of eggs or larvae in the lower San Joaquin River, ER is the entrainment rate, S_{15} is the survival rate for lower San Joaquin River eggs and larvae, and S_{nat} is the natural rate of survival to 38 mm.

Larval Redistribution. The redistribution of larvae after initial spawning or carriage by the Sacramento River to the Delta is calculated relative to the entrainment rate. Movement out of the lower San Joaquin River via outflow is calculated by:

$$SJLOSS = N \times ER \times (1 - S_{15}) / \ln S_{15} \times S_{nat} \times SJOUT$$

where N, ER, S_{15}, S_{nat}, and SJOUT are as described previously. Movement out of the lower Sacramento River via diversion, outflow, or flow into the San Joaquin River is calculated similarly:

$$SACLOSS = N \times ER \times (1 - S_{15}) / \ln S_{15} \times S_{nat} \times BBB$$

where N is the number of larvae in the lower Sacramento River and ER, S_{15}, S_{nat}, and SJOUT are as described previously. BBB is either FSJ, SACOUT, or DIV for calculating movement with flow to the lower San Joaquin River, outflow, or diversion.

Summary. Losses (expressed as 38-mm equivalents) to diversions east of the Sacramento River, survival in the Delta, and survival of larvae moving with outflow are totaled for each 15-day interval for each group of eggs spawned. Losses to diversions are converted to yearling equivalents and compared by month for April through August between years. Surviving larvae are totaled for each year and indexed to a maximum 38-mm index of 120. The 38-mm indices are calculated for each year and compared between years.

Entrainment Loss Model for Striped Bass Greater than 38 mm Long

Base Entrainment per TAF. The distribution of striped bass is affected by export and Delta outflow conditions, but fish behavior in response to other factors probably has a greater influence than flow conditions would have on the movement of bass >38 mm long. Conditions that govern the distribution of bass >38 mm long are assumed constant for all years, and entrainment is assumed to be a function of the volume of water exported.

The density of striped bass entering Clifton Court Forebay in the future is assumed to be similar to densities that occurred during the 1981-1989 period. Under this assumption, increased pumping would cause more fish to enter the forebay. Densities at Clifton Court Forebay are assumed to be representative of densities at the CVP intake. Salvage numbers for the SWP fish protection facility (1981-1989) are converted to the number of fish exposed to the screens by dividing by screen efficiency. The worst-case average efficiency calculated for 1968-1980 was used for each size class (i.e., 0.72 for fish >30 mm in length) (California Department of Fish and Game 1987b).

The number of fish exposed to the screens is converted to the number of fish exposed to entrainment by dividing by 1 minus the predation rate. Predation rates are based on fish length (Table 6). The number of fish exposed to entrainment is divided by the volume of export to obtain entrainment per TAF of export. Values for each month are averaged for the 1981-1988 period and converted to yearling equivalents from each size class by multiplying each month's total by the yearling equivalent factors in Table 6.

Entrainment Vulnerability. The number of fish entrained is calculated by multiplying the number exposed per TAF (calculated by the methods detailed in the previous section) by the diversion from the Delta. The total for all months and all size classes is the entrainment loss for unscreened intakes.

Total entrainment loss for screened intakes is calculated by:

$$N = \text{Diversion x } N_f \text{ x Loss Rate}$$

where N_f is the number of fish exposed to entrainment per TAF of diversion, in each size class, and Loss Rate includes predation rate, screen efficiency, and tracking and handling loss rates (California Department of Fish and Game 1987b) (Table 7).

Delta Smelt and Sacramento Splittail

Detailed information on the abundance and movement of Delta smelt and Sacramento splittail larvae is unavailable. Change in the 38-mm survival index for striped bass will be used as an indicator of similar change to be expected for Delta smelt and Sacramento splittail. Some Delta smelt spawning and occurrence of the larvae in the Delta occurs before spawning of striped bass. The Delta Diversion Index will be used to evaluate qualitatively the effects of flow conditions on Delta smelt and Sacramento Splittail during February through June.

Table 6. Yearling Equivalent Factors for Striped Bass Based on a Natural Instantaneous Mortality Rate of 0.0117

Month	Yearling Equivalent Factor
October	0.59762
November	0.84891
December	1.00000
January	1.00000
February	1.00000
March	0.04887
April	0.06942
May	0.09977
June	0.14339
July	0.20368
August	0.29273
September	0.41582

Source: California Department of Water Resources 1986.

Table 7. Striped Bass Predation, Screening Efficiency, and Handling and Trucking Loss by Length for the State Water Project (SWP) Intake

Length (mm)	SWP Loss Rate				
	Predation	Efficiency	Handling	Trucking	Total
25	0.92	0.45	0.36	0.33	0.99
30	0.82	0.45	0.34	0.30	0.97
35	0.75	0.72	0.31	0.28	0.86
40	0.68	0.72	0.29	0.25	0.81
50	0.60	0.72	0.24	0.20	0.76
60	0.50	0.72	0.19	0.16	0.68
70	0.41	0.72	0.14	0.11	0.61
80	0.35	0.72	0.09	0.06	0.56
90	0.28	0.72	0.04	0.01	0.49
100	0.22	0.72	0.00	0.00	0.44
110	0.18	0.72	0.00	0.00	0.41
120	0.14	0.72	0.00	0.00	0.38
130	0.10	0.72	0.00	0.00	0.35
140	0.06	0.72	0.00	0.00	0.32
150	0.03	0.72	0.00	0.00	0.30
>150	0.00	0.72	0.00	0.00	0.28

Note: Adapted from California Department of Fish and Game 1987b and California Department of Water Resources 1990b.

Section C

Terrestrial Biology

Section C-1. Special-Status Plant Species Known or Suspected to Occur in the Project Area

Species	Status[a] Federal/State/CNPS	Distribution[b]	Habitat Association	Reasons for Special-Status Designation	Periods of Identification
Amsinckia grandiflora Large-flowered fiddleneck	E/E/1b	Historically reported from foothills of Mt. Diablo Range in Alameda, Contra Costa, and San Joaquin Counties; currently known from two sites near Corral Hollow, about 17 miles (27 km) southwest of the study site	Lower portions of steep, protected, north- and east-facing slopes in grasslands and oak woodlands	Historical declines possibly attributable to urban land conversions; fire suppression; effects of aggressive, non-native species that dominate grasslands; and preferential livestock grazing	March-April
Arctostaphylos auriculata Mt. Diablo manzanita	C3c/--/4	Foothills and upper slopes of Mt. Diablo Range in Alameda and Contra Costa Counties	Sandstone-derived soils of upper canyon slopes in chaparral vegetation; along lower canyon slopes at edge of live oaks (Bowerman 1944)	No declines noted (Booker, Holton and Associates 1983); range limited by natural factors; nearly all occurrences on protected or undevelopable land	Year round
Arctostaphylos pallida Alameda manzanita	C2/E/1b	Foothills and upper slopes of Mt. Diablo Range in Contra Costa County	Dry, sandy, or rocky ridges below 2,200 feet (670 m) in mixed chaparral (Bowerman 1944)	No recent declines noted (California Natural Diversity Data Base 1991); naturally limited range within rapidly expanding urban area	Year round
Aster chilensis var. *lentus* Suisun Marsh aster	C2/--/1b	Brackish marshes around San Francisco, San Pablo, and Suisun Bays in Contra Costa, San Joaquin, and Solano Counties	Brackish, saltwater, and freshwater marshes within or above the zone of tidal fluctuation	Naturally limited distribution and habitat loss from urban land conversion	August-November
Atriplex cordulata Heartscale	C2/--/3	San Joaquin and southern Sacramento Valleys in Contra Costa, Solano, Glenn, Colusa, Stanislaus, San Joaquin, Merced, Madera, Fresno, and Tulare Counties (Hall and Clements 1923, Berg pers. comm.)	Alkali sink seasonal wetlands; scalds and sparely vegetated sites in valley sink scrub, alkali meadow, and alkali grassland communities	Has suffered substantial reductions in habitat from urban and agricultural land conversions; sensitive to livestock grazing	June-August
Atriplex depressa Brittlescale	C2/--/3	Central Valley in Glenn, Colusa, Fresno, Madera, Merced, Stanislaus, Tulare, and Yolo Counties (Hall and Clements 1923, Berg pers. comm.)	Alkali sink seasonal wetlands; scalds and sparsely vegetated sites in valley sink scrub, alkali meadow, and alkali grasslands	Has suffered substantial reductions in habitat from urban and agricultural land conversions; sensitive to livestock grazing	June-August
Atriplex patula ssp. *spicata* San Joaquin spearscale	C2/--/3	Central Valley and adjacent valleys of inner Coast Ranges in Alameda, Contra Costa, Colusa, Glenn, San Benito, Solano, and Yolo Counties (Smith and Berg 1988)	Alkali sink seasonal wetlands; scalds and sparsely vegetated sites in valley sink scrub, alkali meadow, and alkali grasslands	Has suffered substantial reductions in habitat from urban and agricultural land conversions; sensitive to livestock grazing	March-July

Species	Status[a] Federal/State/CNPS	Distribution[b]	Habitat Association	Reasons for Special-Status Designation	Periods of Identification
Cirsium crassicaule Slough thistle	C2 /–/1b	Sacramento-San Joaquin Delta; occurred historically throughout the San Joaquin Valley	Slow-moving water with saturated soils in various plant communities along sloughs, canals, and rivers	Habitat loss from agricultural and urban land conversion; water diversions and canal and bank maintenance activities	June-August
Cordylanthus mollis ssp. *hispidus* Hispid bird's beak	C2/–/1b	Southern Sacramento Valley in Placer County south to Kern County in southern San Joaquin Valley and Livermore Valley	Alkali seasonal wetlands including valley sink scrub, alkali meadow, and alkali marsh	Has suffered substantial reductions in habitat from urban and agricultural land conversions; sensitive to livestock grazing	June-August
Cordylanthus palmatus Palmate-bracted bird's beak	E/E/1b	Widespread but infrequent in southern Sacramento and northern San Joaquin Valleys; extant at five sites, including Livermore Valley	Seasonal wetlands include valley sink scrub, alkali meadow, and alkali marsh	Has suffered substantial reductions in habitat from urban and agricultural land conversions; sensitive to livestock grazing	June-August
Delphinium recurvatum Recurved larkspur	C2/–/1b	Historically widespread in San Joaquin Valley and adjacent Coast Range foothills from Solano to Kern County	Valley bottoms with seasonal alkali wetlands and heavy clay alkali soils	Has suffered substantial reductions in habitat from urban and agricultural land conversions	March-April
Eriogonum truncatum Mt. Diablo buckwheat	C2/–/1b	Northern portion of Mt. Diablo Range in Alameda, Contra Costa, and Solano Counties; common on Mt. Diablo	Bedrock outcrops, rock scree (serpentine on Mt. Diablo), or thin, rocky soil in grassland, oak woodland, and chaparral; on serpentine on Mt. Diablo	Many historic populations cannot be relocated	Late March-May
Erysimum capitatum var. *angustatum* Contra Costa wallflower	E/E/1b	Antioch Dunes historical populations may have occurred elsewhere in the Delta	Inland dune formations in sandy soils along riverbanks with sparse vegetative cover	Naturally limited distribution and habitat loss due to urban land conversion	March-July
Eschscholzia rhombipetala Diamond-petaled California poppy	C2/–/1b	Coast Ranges in San Luis Obispo, Stanislaus, San Joaquin, Contra Costa, and Alameda Counties; historical population reported from south of Byron	Poorly documented, odd soils in grassland, oak woodland, and chaparral such as heavy clay or rocky scree	Species widespread but spotty; threats stem from low population numbers; recent declines documented, possibly affected by livestock grazing	Late March-May
Fritillaria agrestis Stink bells	–/–/4	Northern and southern Coast Ranges from San Luis Obispo to Mendocino County	Heavy clay soils of valley bottoms and canyon slopes in grasslands and oak woodlands	Known from relatively few, widely scattered populations; sensitive to livestock grazing	March-April

Species	Status[a] Federal/State/CNPS	Distribution[b]	Habitat Association	Reasons for Special-Status Designation	Periods of Identification
Fritillaria liliacea Fragrant fritillary	C2/–/4	Coast Ranges and adjacent western edge of Central Valley from San Benito to Sonoma County	Heavy clay soils of valley bottoms and canyon slopes in grasslands and oak woodlands	Low number of populations; recent losses from urban and agricultural development; sensitive to grazing	March-April
Helianthella castanea Diablo helianthella	C2/–/1b	Mt. Diablo Range, Berkeley Hills, San Bruno Mountains, and San Francisco-Bay View Hills	Rocky sites with open to partially shaded canopy of various oak species; often at oak woodland-chaparral ecotone; 500-4,000 feet (150-1,220 m) elevation	Limited number of occurrences within a rapidly expanding urban area; nearly all populations protected within state or East Bay regional parks	April-July
Hesperolinon breweri Brewer's dwarf flax	C2/–/1b	Northern Mt. Diablo Range in Contra Costa and Alameda Counties and Vaca Mountains in Solano and Napa Counties	Bedrock outcrops; rock scree; clay soils with low herb cover; annual grasslands and openings in various oak woodland and chaparral communities	Evidence of recent declines unknown; natural distribution restricted to urbanizing counties but most occurrences in protected sites	April-May
Hibiscus californicus California hibiscus	C2/–/1b	San Joaquin-Sacramento River Delta and southern Sacramento Valley south of Glenn and Butte Counties; Clifton Court Forebay, 11 miles (18 km) east of Kellogg Creek watershed, nearest reported occurrence	Freshwater and tidal marshes with permanently saturated soil; banks of sloughs, tule islands, oxbows, and backwater areas protected from turbulent floodwater and bank erosion	Restricted to an area of intense agricultural development; threatened by land conversion, canal and bank maintenance, water development projects, and increased salinity of Delta waters	July-November
Lasthenia conjugans Contra Costa goldfields	C1/–/1b	Historically widespread in Coast Ranges from Mendocino to Santa Barbara Counties; believed extant in Alameda, Contra Costa, Solano, and Napa Counties; nearest reported population 5 miles (8 km) northeast of Kellogg Creek watershed	Seasonal wetlands, including vernal pools, vernal meadows, and riverbanks; typically in alkaline, clay-based soils	Limited number of extant occurrences compared to historic extent; occurrences in areas of rapid urban and agricultural expansion	March-April
Lathyrus jepsonii ssp. *jepsonii* Delta tule pea	C2/–/1b	Central Valley from Butte to Tulare County, Jepson Prairie	River and canal banks in brackish and freshwater marshes, and in riparian woodlands, above the zone of tidal influence	Habitat loss from agricultural and urban land conversion; water diversion projects	May-July

Species	Status[a] Federal/State/CNPS	Distribution[b]	Habitat Association	Reasons for Special-Status Designation	Periods of Identification
Lilaeopsis masonii Masons lilaeopsis	C2/R/1b	Suisun Bay and Delta in area inundated by tidal fluctuations	Clay-peat deposits in marsh vegetation along edges of waterways; restricted to the tidal zone	Habitat loss from agricultural and urban development	Year round during low tide
Neostapfia colusana Colusa grass	C2/E/1b	Northern San Joaquin Valley in Merced and Stanislaus Counties and southern Sacramento Valley from Colusa and Solano Counties	Large northern claypan vernal pools with alkaline soils that remain flooded until early summer in normal years	Limited number of extant occurrences in areas threatened by agricultural land conversions	June-August
Oenothera deltoides var. *howellii* Antioch Dunes evening primrose	E/E/1b	Known only from the Antioch Dunes, may have been more widespread historically in the Sacramento-San Joaquin Delta	Inland dune formations in sand to sandy soils; riverbanks with sparse vegetative cover	Naturally limited distribution; habitat loss due to agricultural and urban land conversion	March-July
Phacelia phacelioides Mt. Diablo phacelia	C2/–/1b	South Coast Ranges in upper elevations of Mt. Hamilton (Santa Clara and Stanislaus Counties) and Mt. Diablo (Contra Costa and Alameda Counties) Ranges	Bedrock, rock scree, or thin, rocky soils; above 2,000 feet elevation; openings in oak woodland and chaparral communities; colonizes chaparral after wildfire (Bowerman 1944)	Limited in geographic range and number of occurences	April-May
Sagittaria sanfordii Sanfords sagittaria	C2/–/1b	Widespread but infrequent throughout northern and central California	Sloughs and sluggish streams with silty or muddy substrate, associated with emergent aquatic marsh vegetation	Widespread but infrequent; rarity and endangerment status not known	year round
Streptanthus hispidus Mt. Diablo jewel flower	C2/–/1b	Slopes of Mt. Diablo above 2,000 feet	Bedrock and rock scree in oak woodland and chaparral; colonizes burned chaparral (Bowerman 1944)	Limited geographic range and small number of occurrences	April-May
Trifolium amoenum Showy Indian clover	C2/–/1a	Historically widespread in Coast Ranges from Santa Clara County north to Mendocino County; believed extinct; nearest historic site 10 miles (16 km) west of Tracy, east of Kellogg Creek watershed	Mesic, protected locales in grasslands and oak woodlands	No extant populations known; eliminated by urban land conversion, livestock grazing, and competition with non-native grasses	March-April

Species	Status[a] Federal/State/CNPS	Distribution[b]	Habitat Association	Reasons for Special-Status Designation	Periods of Identification
Tropidocarpum capparideum Caper-fruited tropidocarpum	C2/--/1a	Historically widespread in Central Valley and bordering foothills from Monterey to Glenn Counties; numerous sitings from plains surrounding Mt. Diablo; nearest siting near Byron, 6 miles east of Kellogg Creek watershed	Grassland and oak woodland communities on alkaline-clay soils	No extant populations known; eliminated by land conversion and livestock grazing	March-April
Tuctoria mucronata Crampton's tuctoria	E/E/1b	Known from a limited portion of Solano County	Claypan vernal pools with heavy-alkaline soils	Naturally limited distribution and habitat loss from agricultural land conversions	July-August

Note: -- = no listing.

[a] Status definitions:

Federal = USFWS (FR 50:39526-395840)

E = listed as endangered under the federal Endangered Species Act.

C1 = category 1 candidate for federal listing. Category 1 includes species for which USFWS has on file enough substantial information on biological vulnerability and threat to support proposals to list them.

C2 = category 2 candidate for federal listing. Category 2 includes species for which the USFWS has some biological information indicating that listing may be appropriate, but for which further biological research and field study are needed to clarify the most appropriate status.

Note: Category 2 species are not necessarily less rare, threatened, or endangered than Category 1 species or listed species; the distinction relates to the amount of data available and is therefore administrative, not biological.

C3c = no longer a candidate for federal listing. Category 3 species have been dropped from the candidate list because they are extinct (C3a), taxonomically invalid or do not meet the USFWS definition of a "species" (C3b), or too widespread or not threatened at this time.

State = DFG (1987b)

E = listed as endangered under the state Endangered Species Act.

R = listed as rare under the California Native Plant Protection Act.

CNPS = California Native Plant Society (Smith and Berg 1988)

1a = list 1a species: presumed extinct in California.

1b = list 1b species: rare, threatened, or endangered in California and elsewhere.

3 = List 3 species: plants about which more information is needed to determine their status.

4 = List 4 species: plants of limited distribution.

[b] Source: Smith and Berg 1988.

Section C-2. Summary of the Distribution and Importance of Natural Communities That Occur in the Project Area

Summary of the Distribution and Importance of Natural Communities Present in the Project Area

Natural Community	Characteristic Plant Species	Distribution in California	Reasons for Decline of Significant Natural Communities and Threats to Remaining Occurrences	Distribution in Project Area	Importance of Project Area Occurrences
Grassland communities					
Annual grassland	Soft chess, red brome, wild oat, foxtail barley, zorro fescue, lupine, clarkia, fiddleneck, and popcorn flower	Throughout lowland California, southern Oregon, and northern Baja	N/A	From edges of wetlands in valley bottoms, throughout foothills to rocky ridgetops	Provides an important source of forage for livestock and protects watershed land from erosion
Valley needlegrass grassland	Purple needlegrass, pine bluegrass, California melic grass, lupine, clarkia, and brodiaea	Remnants throughout lowland and cismontane California; best representatives found in the central and southern portions of the Coast Ranges	Preferential grazing by livestock; competition from non-native Mediterranean grasses; and a reduction in the frequency of wildfires, threatened statewide by habitat conversion, agriculture, and grazing	Primarily on mesic or north-facing slopes	Considered of high quality because of the extent and the prevalence of bunchgrass species (20-50% relative cover in some areas)
Alkali wetland communities[a]					
Alkali grassland[b]	Low and Mediterranean barley, Italian ryegrass, goldfields, peppergrass species, saltmarsh sand-spurrey, adobe and rough-fruited popcorn flower, nodding microseris, and slender plantain	Remnants throughout the San Joaquin Valley and southern Sacramento Valley, and adjacent valleys of the Coast Ranges	Land conversion to agricultural and urban uses and livestock grazing	Northeast and south-central portions of the watershed from the eastern edge of the watershed east to Byron Tract, north to the City of Byron, and south to Livermore	Considered important because of current scarcity relative to historical extent; provide habitat for special-status plant species; performs ecological functions such as water filtration, groundwater recharge, livestock water sources, and bank stabilization
Alkali meadow	Saltgrass, alkali heath, seepweed, crown saltbush, large-flowered sand-spurrey, and wirerush	Same as alkali grassland	Land conversion to agricultural and urban uses and livestock grazing	Same as alkali grassland	Same as alkali grassland; associated with brittlescale and San Joaquin spearscale
Valley sink scrub	Patchy shrub layer of iodine bush and seepweed with an understory of typical alkali meadow and alkali grassland species	Remnants throughout the western portion of the San Joaquin Valley, in Livermore Valley, and valley bottoms of the inner Coast Ranges	Land conversion to agricultural and urban uses and livestock grazing	Same as alkali grassland	Same as alkali grassland; associated with brittlescale and San Joaquin spearscale
Alkali marsh/alkali seep	Narrow-leaved cattail, hard-stem bulrush, alkali bulrush, spike-rush, saltgrass, common monkeyflower, rabbitsfoot grass, and brass button	Same as alkali grassland	Land conversion to agricultural and urban uses and livestock grazing	Edge of intermittent and perennial creeks and stock ponds	Same as alkali grassland; provides one of the few year-round sources of water for locally occurring wildlife species

Natural Community	Characteristic Plant Species	Distribution in California	Reasons for Decline of Significant Natural Communities and Threats to Remaining Occurrences	Distribution in Project Area	Importance of Project Area Occurrences
Northern claypan vernal pool	Low barley, coyote thistle, Howell's foxtail, woolly marbles, downingia, mousetails, goldfields, stipitate and fine-branched popcorn flower, tricolor monkeyflower, and hyssop loosestrife	Historically widespread in the Central Valley from Glenn County to the southern end of the San Joaquin Valley and inner South Coast Ranges	Land conversion to agricultural and urban uses and livestock grazing	Northern half of the watershed and from there east to Byron Hot Springs and Clifton Court Forebay	Same as alkali grassland; vernal pools in project area are degraded by livestock
Intermittent pool communities[a]					
Valley rock outcrop intermittent pool	Lillaea, quillwort, goldfield species, common monkeyflower, water starwort, and pillwort fern	Extremely limited; project area occurrences are the only known in California	Extreme rarity makes this community susceptible to elimination	Two occurrences located north of Dyer Road and one occurrence in the Kellogg Creek watershed	Only known occurrences in California
Riparian woodland communities					
Willow-cottonwood riparian woodland	Fremont's cottonwood, Goodding's willow, and arroyo willow; shrub layer of buttonbush, wild grape, mule fat, blackberry, and California wild rose; understory of creeping wild rye and soft chess; Pacific rush, watercress, and aquatic buttercup	Throughout the Coast Ranges and Central Valley	Land conversion, water diversion, and livestock grazing	Intermittent drainages and creeks throughout the project area	Performs important ecological functions such as water filtration and bank stabilization; provides important habitat for dependent plant and wildlife species; considered important because of extreme loss of habitat regionally and statewide
Central coast live oak riparian woodland	Coast and interior live oak with scattered valley oak, willow, Fremont's cottonwood, white alder, sycamore, and buckeye; understory of ferns, horsetail, creeping wildrye or annual grassland species; creek channels also with common monkey-flower, Pacific rush, watercress, and torrent sedge	Throughout mountain and foothill creeks in the central Coast Ranges	Same as willow-cottonwood riparian woodland	Foothill creeks and intermittent drainages west of Vasco Road; less frequent east of Vasco Road	Same as willow-cottonwood riparian woodland
Mixed riparian woodland	Overstory of sycamore, walnut, valley oak and Fremont's cottonwood; midstory of willow, elderberry and mule fat; understory of mugwort and creeping wildrye	Remnants throughout lowland California	Land conversion to agricultural and urban uses, grazing, firewood harvest, and water diversions	Marsh Creek	Provides important forage and cover for wildlife; considered of high quality because of its diversity, maturity, and relatively pristine condition; considered important because of current scarcity relative to historical extent

Natural Community	Characteristic Plant Species	Distribution in California	Reasons for Decline of Significant Natural Communities and Threats to Remaining Occurrences	Distribution in Project Area	Importance of Project Area Occurrences
Chaparral communities					
Diablan sage scrub	Dense shrub layer of chamise, black sage, California sage, matchweed, poison-oak, Mt. Diablo manzanita, bush monkeyflower and California buckwheat; canopy openings often support annual grassland species	Widespread from Vaca Mountains in Solano and Napa Counties south to Cholame Hills in San Luis Obispo County	N/A	Arid southern slopes in the western half of the watershed	Provides important forage and cover for dependent wildlife and plant species; protects lands from erosion; maintains water quality; supports special-status plant species (e.g., Mt. Diablo manzanita, Diablo Helianthella, Brewer's dwarf flax)
Northern mixed chaparral	Dense shrub layer of buckbrush, common manzanita, yerba santa; often mixed with chamise and California sage on arid eastern and northern slopes; toyon, poison-oak, scrub oak, coyote brush, and chaparral currently on mesic slopes; herbaceous layer in canopy openings of annual grassland species	Throughout cismontane California in the Coast Ranges, Sierra Nevada, and Cascade Mountains	N/A	Slopes in the western half of the watershed	Same as Diablan sage scrub
Oak woodland communities					
Blue oak woodland	Overstory of predominately blue oaks, sometimes intermixed with live oak and digger pine; shrub layer absent or sparse, consisting of poison-oak, California buckeye, hoptree, and common manzanita; herbaceous layer of pine bluegrass, California melic grass, purple needlegrass, and annual grassland species	Throughout cismontane California; encompassing most of the Central Valley	N/A	Foothill slopes of the watershed	Long-term viability of blue oak stands and continued statewide losses from land conversion increase importance of project area occurrences; provides important habitat for dependent plant and wildlife species
Valley oak woodland	Valley oak, sometimes with live oak and Fremont's cottonwood; herbaceous layer of annual grassland species	Throughout the Central Valley and valleys of cismontane California	Land conversion to agricultural and urban uses, livestock grazing, firewood harvest; valley oak woodlands reported to have problems regenerating	Intermittent drainages and creeks and in adjacent floodplains in valley bottoms throughout the watershed; other remnant occurrences in valleys north of the watershed	Provides important forage and cover for dependent wildlife and plant species; considered important because of extreme regional and statewide scarcity

Natural Community	Characteristic Plant Species	Distribution in California	Reasons for Decline of Significant Natural Communities and Threats to Remaining Occurrences	Distribution in Project Area	Importance of Project Area Occurrences
Live oak woodland	Overstory of coast and interior live oaks, with a sparse shrub layer of poison-oak, coffeeberry, toyon, and buckbrush; often with a herbaceous layer of annual grassland species	Throughout cismontane California and southern Coast Ranges	N/A	Mesic north- and east-facing slopes of foothills in the western portion of the watershed	Same as blue oak woodlands
Mixed north slope cismontane woodland	Blue oak, live oak, digger pine with well-developed shrub layer of common manzanita, California sage, buckeye, redberry, California bay, buckbrush, toyon, and hoptree; understory of annual grassland species	Northern and southern Coast Ranges from Humboldt County south to San Luis Obispo County	N/A	Foothills west of Vasco Road	Same as blue oak woodlands
Coastal marsh community[a]					
Brackish marsh	Herbaceous vegetation, including fleshy jaumea, sedge species, seaside arrowgrass, beach silverweed, saltgrass, and alkali heath	Along interior edges of coastal bays, deltas, and estuaries; most extensively developed around Suisun Bay in the Sacramento-San Joaquin Delta	Land conversion to urban uses and livestock grazing	Adjacent to Suisun Bay, northwest of the City of Pittsburg	Considered important because of current scarcity relative to historical extent

Note: N/A = information not available.

[a] Indicates areas identified as jurisdictional wetlands, under Section 404 of the Clean Water Act (1977).

[b] Includes areas identified in previous reports as ephemeral drainages or swales.

Section C-3. Special-Status Wildlife Species Known to Occur in the Project Area

Species	Legal Status[a] Federal/State	Distribution	Preferred Habitat	Occurrence in the Project Area	Reasons for Decline
Invertebrates					
Bay checkerspot butterfly *(Euphydryus editha bayensis)*	T/--	Isolated colonies scattered throughout the San Francisco Bay area	Islands of serpentine grassland in chaparral areas	Kellogg Creek watershed: No known occurrences; suitable habitat in western half of watershed; historical record from 1977 on Morgan Territory Road, population thought to be extinct Conveyance facilities: No suitable habitat	Habitat loss; drought may have eliminated host plant (*Plantago erecta*)
California linderiella (*Linderiella occidentalis*)	1R/--	East side of Central Valley from east of Red Bluff to east of Madera, across the Sacramento area and through the central and south Coast Ranges from Lake to Riverside County	Common in vernal pools; also found in sandstone rock outcrop pools	Kellogg Creek watershed: In sandstone rock outcrop pools Conveyance facilities: No known occurrences; potential habitat in vernal pools	Habitat loss to agricultural and urban development
Curve-footed hygrotus diving beetle *(Hygrotus curvipes)*	C2/--	Western side of the San Joaquin Valley from Oakley in Contra Costa County south to Alameda County	Small ponds, roadside ditches, vernal wetlands, and pools in intermittent streams, most of which dry up during the summer and support salt-tolerant vegetation	Kellogg Creek watershed: In water bodies throughout the watershed Conveyance facilities: Potential habitat in suitable water bodies	May be more abundant than once thought
Longhorn fairy shrimp *(Branchinecta longiantenna)*	1R/--	Eastern margin of central Coast Ranges from Contra Costa to San Luis Obispo County	Small, clear pools in sandstone rock outcrops or clear to moderately turbid clay- or grass-bottomed pools	Kellogg Creek watershed: In sandstone rock outcrop pools Conveyance facilities: No known occurrences; potential habitat in vernal pools	Habitat loss
Moestan blister beetle *(Lytta moesta)*	C2/--	Inhabits the Central Valley from Contra Costa to Kern and Tulare Counties	Moist, loose soils in seasonal wetlands or vernal pools	Kellogg Creek watershed: No known occurrences Conveyance facilities: No known occurrences	Loss of vernal pools and other seasonal wetlands
Molestan blister beetle *(Lytta molesta)*	C2/--	Inhabits the Central Valley from Contra Costa to Kern and Tulare Counties	Moist, loose soils in seasonal wetlands or vernal pools	Kellogg Creek watershed: No known occurrences Conveyance facilities: Collected near Brentwood at site 3 miles southwest of Brentwood	Loss of vernal pools and other seasonal wetlands

Species	Legal Status[a] Federal/State	Distribution	Preferred Habitat	Occurrence in the Project Area	Reasons for Decline
San Francisco forktail damselfly *(Ischnura gemina)*	C2/--	Point Reyes peninsula, San Francisco, South Bay, East Bay to Berkeley, Suisun City	Small shallow ponds, slow streams, marshes, canals, permanent water sources with some emergent vegetation (Wilson pers. comm.)	Kellogg Creek watershed: No known occurrences; potential habitat in project area water bodies Conveyance facilities: No known occurrences; potential habitat in project area water bodies	Habitat loss and changes in water flows
Valley elderberry longhorn beetle *(Desmocerus californicus dimorphus)*	T/--	Streamside habitats throughout the Central Valley and Sacramento/San Joaquin River Delta	Riparian habitats with elderberry shrubs	Kellogg Creek watershed: Potential habitat found along Vasco Road outside inundation zone Conveyance facilities: Potential habitat may occur along Middle and Old Rivers	Loss of riparian habitat
Vernal pool fairy shrimp *(Branchinecta lynchi)*	1R/--	Central Valley, central and south Coast Ranges from Tehama to Santa Barbara County; isolated populations also in Riverside County	Common in vernal pools; also found in sandstone rock outcrop pools	Kellogg Creek watershed: In sandstone rock outcrop pools Conveyance facilities: No known occurrences; potential habitat in vernal pools	Habitat loss to agriculture and urban development
Vernal pool tadpole shrimp *(Lepidurus packardi)*	2R/--	Sacramento Valley	Vernal pools	Kellogg Creek watershed: Potential habitat in vernal pools Conveyance facilities: Potential habitat in vernal pools	Habitat loss to agricultural and urban development
Amphibians					
California red-legged frog *(Rana aurora draytoni)*	C1/SSC	British Columbia south to northern Baja California	Permanent aquatic habitats, such as creeks and ponds, with emergent and submergent vegetation; may estivate in burrows during dry periods	Kellogg Creek watershed: In Kellogg and Brushy Creeks, and several stock ponds Conveyance facilities: Potential habitat in creeks and stock ponds	Habitat destruction and competition and predation by fish and bullfrogs
California tiger salamander *(Ambystoma tiginum californiense)*	C2/SSC	Butte County in north to Santa Barbara County in south	Open woodlands and grasslands; requires aquatic areas such as ponds or streams for breeding; burrows up to 1 mile from breeding site during summer dormancy	Kellogg Creek watershed: In stock ponds and Kellogg Creek Conveyance facilities: Potential habitat in stock ponds and adjacent upland annual grassland habitat	Loss of grassland habitat to agricultural and urban uses

Species	Legal Status[a] Federal/State	Distribution	Preferred Habitat	Occurrence in the Project Area	Reasons for Decline
Reptiles					
Western pond turtle (*Clemmys marmorata*)	C1/SSC	Western Washington south to Baja California	Still waters such as ponds, reservoirs, and sluggish streams	Kellogg Creek watershed: In permanent pools in Kellogg Creek and stock pond about 1 mile east of the proposed dam sight Conveyance facilities: Potential habitat in slow-moving sloughs and creeks; one observed in Marsh Creek Reservoir	Loss of aquatic habitat to agricultural development, water diversion, stream channelization, and urbanization; loss of breeding habitat adjacent to aquatic habitat
California horned lizard (*Phrynosoma coronatum frontale*)	--/SSC	Sacramento Valley and adjacent foothills south to southern California	Grasslands, brushlands, and woodlands with loose soils	Kellogg Creek watershed: Potential habitat in chaparral and oak woodland habitats; soil compaction from cattle has reduced habitat quality Conveyance facilities: No suitable habitat	
Alameda whipsnake (*Masticophis lateralis euryxanthus*)	C2/T	Alameda and Contra Costa Counties	Valleys, foothills, and low mountains in ecotonal areas of dry coastal scrub with grassland, oak woodland, or riparian vegetation	Kellogg Creek watershed: In suitable habitat Conveyance facilities: No suitable habitat	Habitat loss caused by urban expansion
Giant garter snake (*Thamnophis couchi gigas*)	1R/T	Central Valley from Butte County to Kern County, including the northern and eastern portions of the Sacramento/San Joaquin River Delta	Marshes or shallow sloped channels with emergent vegetation and associated grassy uplands	Kellogg Creek watershed: No suitable habitat Conveyance facilities: Potential habitat may occur along Middle and Old Rivers	Loss of marsh habitats
Birds					
Aleutian Canada goose (*Branta canadensis leucopareia*)	E/--	Winters in the Central Valley; major use areas at the junction of the Tuolumne and San Joaquin Rivers	Grain crops and pasture for foraging, ponds for resting	Kellogg Creek watershed: No suitable habitat Conveyance facilities: No known use areas along proposed conveyance routes	Predation by Arctic foxes introduced to the Aleutian Islands; habitat loss and hunting

Species	Legal Status[a] Federal/State	Distribution	Preferred Habitat	Occurrence in the Project Area	Reasons for Decline
California clapper rail *(Rallus longirostris obsoletus)*	E/E	Suisun Marsh, San Pablo Bay, San Francisco Bay, and Elkhorn Slough	Tidal marshes dominated by pickleweed and cordgrass; feeds out from cover on molluscs obtained from mud-bottomed sloughs	Kellogg Creek watershed: No suitable habitat Conveyance facilities: East of the species' known range; nearest record, 1985 at Ryer Island, 10 miles northwest of project area	Overharvesting by commercial and sport hunting, 1850-1913; loss of tidal wetland habitat
California black rail *(Laterallus jamaicensis coturniculus)*	C1/T	Point Reyes, San Francisco Bay, Sacramento/San Joaquin River Delta, and southern California	Pickleweeds and tule marshes with adjacent uplands	Kellogg Creek watershed: No suitable habitat Conveyance facilities: Nearest record at Bacon Island bridge on Middle River, approximately 1 mile north of proposed Middle River intake; potential breeding habitat at Suisun Bay near West Pittsburg	Loss of tidal and inland wetlands by filling and draining
Greater sandhill crane *(Grus canadensis tabida)*	--/T	Breeds in northeastern California; winters in Central Valley and Sacramento/San Joaquin River Delta	Forages in wheat and corn fields, fallow land, and uncultivated fields; roosts in shallow water	Kellogg Creek watershed: No suitable habitat Conveyance facilities: No known use areas; potential foraging habitat along proposed facilities	Loss of wetlands for breeding, feeding, and roosting
California least tern *(Sterna antillarum browni)*	E/E	Breeds in southern arm of San Francisco Bay and counties south of Monterey County	Colonial breeder on flat areas with little or no vegetation (e.g., beaches and aircraft carriers)	Kellogg Creek watershed: Outside the known breeding range Conveyance facilities: Mostly outside the known breeding range; three pairs nested in 1988 at the PG&E plant in Pittsburg (NDDB 1991)	Loss of nesting habitat; human disturbance and predation at nest sites
Long-billed curlew *(Numenius americanus)*	C2/--	Breeds in northeastern California; winters in Central Valley, coastal valleys, and Sacramento/San Joaquin River Delta	Forages in wetlands, moist fields, and grasslands	Kellogg Creek watershed: Irregular migrant and winter resident; observed foraging in Los Vaqueros Reservoir inundation zone Conveyance facilities: Potential habitat along proposed facilities	Loss of wetlands for breeding, feeding, and foraging

Species	Legal Status[a] Federal/State	Distribution	Preferred Habitat	Occurrence in the Project Area	Reasons for Decline
Bald eagle *(Haliaeetus leucocephalus)*	E/E	Breeds in northern portion of the state; wintering population extends to southern California	Winters and breeds at large lakes, reservoirs, and rivers with large trees for roosting or nesting	Kellogg Creek watershed: Winter visitor; one migrant was observed during DFG 1980-1982 surveys Conveyance facilities: No suitable nesting or foraging habitat	Habitat loss, pesticide contamination, and human persecution (Detrich 1985)
Golden eagle *(Aquila chrysaetos)*	--/SSC	Resident throughout California	Nests in cliffs or trees, preferably overlooking grasslands where prey is available	Kellogg Creek watershed: Several nesting pairs Conveyance facilities: Potential foraging habitat where prey species present	Habitat loss, human persecution, and declines in prey species abundance
Osprey *(Pandion haliaetus)*	--/SSC	Nests along Coast Ranges north of San Francisco Bay and Sierra Nevada north of Lake Tahoe; wintering population extends into southern California	Winters and breeds at large lakes, reservoirs, and rivers	Kellogg Creek watershed: Rare winter visitor; one observed during DFG 1980-1982 surveys and during Jones & Stokes Associates 1988 survey Conveyance facilities: No suitable nesting or foraging habitat	Habitat loss, pesticide contamination, and human disturbance during breeding season
Black-shouldered kite *(Elanus caeruleus)*	--/CP	Open habitats throughout California, excluding deserts	Nests in riparian habitats, woodlands, and isolated trees; forages in agricultural fields, grasslands, and wetlands	Kellogg Creek watershed: Potential foraging and wintering habitats Conveyance facilities: Potential nesting habitat near Old and Middle Rivers	
American peregrine falcon *(Falco peregrinus anatum)*	E/E	Nests in Sierra Nevada and Coast Ranges; winters throughout California, excluding deserts	Nests on cliffs; forages in wetlands, grasslands, and coastal areas	Kellogg Creek watershed: Rare winter visitor; four observed during DFG 1980-1982 surveys Conveyance facilities: Uncommon winter visitor; low-quality foraging habitat	Habitat loss and pesticide contamination (California Department of Fish and Game 1983)
Prairie falcon *(Falco mexicanus)*	--/SSC	Throughout California in suitable habitat	Nests on cliff ledges; feeds on insects, small mammals, and birds	Kellogg Creek watershed: Observed foraging and nesting Conveyance facilities: Potential foraging habitat	Pesticide contamination, human persecution, decline in prey species abundance

Species	Legal Status[a] Federal/State	Distribution	Preferred Habitat	Occurrence in the Project Area	Reasons for Decline
Northern harrier *(Circus cyaneus)*	–/SSC	Lowlands and valleys throughout California	Nests in dense grasslands and wetlands; forages in wetlands, grasslands, and agricultural fields	Kellogg Creek watershed: Nests in ungrazed wetlands and grasslands, forages in grasslands Conveyance facilities: Ungrazed wetlands and grasslands are potential nesting habitats; grasslands and agricultural fields provide suitable foraging habitat	Loss of wetlands and grasslands
Swainson's hawk *(Buteo swainsoni)*	–/T	Breeds in the Central Valley and Klamath Basin	Forages in agricultural fields and grasslands with low herbaceous cover; nests in mature trees	Kellogg Creek watershed: No nesting birds were observed during field surveys; one migrant was observed during DFG 1980-1982 surveys Conveyance facilities: No known nesting sites; potential foraging habitat	Loss of grasslands and agricultural crops
Ferruginous hawk *(Buteo regalis)*	C2/–	Winters in the Central Valley and Sierra Nevada and Coast Ranges foothills	Open grasslands with perch sites	Kellogg Creek watershed: Important wintering area; four were observed foraging in December 1990 Conveyance facilities: Potential foraging habitat	Conversion of grasslands to agricultural crops and human disturbances
Sharp-shinned hawk *(Accipiter striatus)*	–/SSC	Breeds in small numbers in Sierra Nevada and Coast Ranges north of San Luis Obispo County; widespread during winter; formerly nested in Contra Costa and northern Alameda Counties	Coniferous forests for breeding; riparian woodlands, oak woodlands, and coniferous forests for wintering	Kellogg Creek watershed: Uncommon winter visitor Conveyance facilities: Uncommon winter visitor	Vulnerable to logging, falconry, and habitat loss
Cooper's hawk *(Accipiter cooperii)*	–/SSC	Breeds in the Central Valley, Sierra Nevada, and Coast Ranges; widespread during winter	Nests in dense-canopied trees of oak woodlands, riparian forests, and coniferous forests	Kellogg Creek watershed: Uncommon permanent resident; oak woodlands provide suitable breeding habitat Conveyance facilities: No suitable breeding habitat	Loss of riparian forests and oak woodlands

Species	Legal Status[a] Federal/State	Distribution	Preferred Habitat	Occurrence in the Project Area	Reasons for Decline
Burrowing owl *(Athene cunicularia)*	–/SSC	Open habitats throughout California	Open, dry, and nearly level grassland or prairie habitat	Kellogg Creek watershed: Uncommon permanent resident Conveyance facilities: Uncommon permanent resident in suitable habitat	Habitat loss
Tricolored blackbird *(Agelaius tricolor)*	C2/–	Lowlands and valleys throughout California	Breeds in freshwater marshes and blackberry thickets; forages in wetlands, grasslands, agricultural fields, and irrigated pastures; known to forage up to 5 miles from nesting colony during breeding season	Kellogg Creek watershed: No suitable breeding habitat Conveyance facilities: Nearest known colonies at Marsh Creek Reservoir and Unimin plant	Loss of wetland breeding habitat, nest disturbance, aerial spraying of herbicides and pesticides, and mortality from poisoned grain (Terres 1987, U.S. Fish and Wildlife Service 1985)
Saltmarsh yellow-throat *(Geothlypis trichas sinuosa)*	C2/–	San Francisco Bay; along the coast from Inverness, Marin County to Pescadero, San Mateo County; Suisun Bay, Ryer and Roe Islands (NDDB 1991)	Riparian habitats, freshwater marsh, and brackish water marsh	Kellogg Creek watershed: Outside species' known range Conveyance facilities: Common yellow-throat observed in salt-water and freshwater marsh where brine disposal pipeline enters Suisun Bay	Loss of riparian habitat and tidal wetlands for breeding and feeding
Suisun song sparrow *(Melospiza melodia maxillaris)*	C2/SSC	Suisun Bay from Martinez eastward to Pittsburg and throughout Suisun Marsh	Salt and brackish water marshes; inhabits cattails, tules and other sedges, and salicornia; also known to frequent tangles bordering sloughs	Kellogg Creek watershed: Outside species' known range Conveyance facilities: Species observed in saltwater and freshwater marsh where brine disposal pipeline enters Suisun Bay	Loss of tidal wetlands for breeding and feeding
Great blue heron rookeries *(Ardea herodias)*	–/–[e]	Throughout lowlands and mountain valleys	Colonial nester in tall trees, cliffsides, and sequestered spots on marshes; rookery sites in close proximity to foraging areas (marshes, lake margins, tide-flats, rivers and streams, wet meadows)	Kellogg Creek watershed: No suitable nesting habitat, lone birds observed foraging in water bodies Conveyance facilities: Potential nesting and foraging habitat along rivers and sloughs; nearest rookery about 8 miles north at southern tip of Venice Cut Island in tall eucalyptus trees	Loss of riparian nesting habitat; also pesticides and herbicides in foraging areas

Species	Legal Status[a] Federal/State	Distribution	Preferred Habitat	Occurrence in the Project Area	Reasons for Decline
Waterfowl	–/–[e]	Wetlands and open water throughout California	Marshes, seasonal wetlands, ponds, channels, sloughs, lakes, and reservoirs	Kellogg Creek watershed: Seven waterfowl species observed; most common are mallards and cinnamon teal; stock ponds and seasonal wetlands provide low- to moderate-quality waterfowl habitat Conveyance facilities: Suisun Bay near West Pittsburg supports low- to moderate-quality waterfowl habitat	Loss of wetlands throughout California
Mammals					
Saltmarsh wandering shrew (*Sorex vagrans halicoetes*)	C1/SSC	Southern San Francisco Bay	Tidal marshes with dense cover	Kellogg Creek watershed and conveyance facilities: Outside the species' range	Loss of tidal wetlands for breeding, feeding, and cover
Suisun ornate shrew (*Sorex ornatus sinuosus*)	C1/SSC	San Pablo Bay and Suisun Bay, as far east as Grizzly Island, Solano County	Tidal marshes dominated by cordgrass, pickleweed, and gum-plant; brackish water dominated by tule and cattail	Kellogg Creek watershed: Outside species' known range Conveyance facilities: 4 miles east of the species' known range	Loss of tidal wetlands for breeding, feeding, and cover
Pacific western big-eared bat (*Plecotus townsendii townsendii*)	C2/SSC	Cascade Range and Coast Ranges in Washington, Oregon, and California	Breeds and roosts in caves, abandoned buildings, and mine tunnels	Kellogg Creek watershed: No known roosts or breeding sites; potential habitat in undisturbed caves Conveyance facilities: No suitable breeding or roosting habitat	Human disturbance at roosting and breeding sites
Salt marsh harvest mouse (*Reithrodontomys raviventris*)	E/E	San Francisco Bay, San Pablo Bay, and Suisun Bay east to Collinsville, Solano County	Tidal marshes dominated by pickleweed; adjacent uplands used as escape habitat from high tides; does not burrow, builds loosely organized nests	Kellogg Creek watershed: Outside species' range Conveyance facilities: Potential habitat at Suisun Bay near West Pittsburg	Loss of tidal wetlands for breeding, feeding, and cover; loss of adjacent uplands as escape cover from flooding; habitat fragmentation; land subsidence; vegetation change

Species	Legal Status[a] Federal/State	Distribution	Preferred Habitat	Occurrence in the Project Area	Reasons for Decline
San Joaquin pocket mouse *(Perognathus inornatus inornatus)*	C2/–	Eastern side of San Joaquin Valley and possibly in Sacramento Valley	Friable soils in grasslands and blue oak savannas	Kellogg Creek watershed: 10 individuals live-trapped by DFG in 1980-1982 study; cattle grazing reduces habitat quality Conveyance facilities: Potential habitat	Loss of uncultivated grasslands and blue oak savannas
San Pablo vole *(Microtus californicus sanpabloensis)*	C2/–	San Pablo Creek, Contra Costa County	Salt marshes	Kellogg Creek watershed and conveyance facilities: Outside the species' known range	Loss of tidal wetlands for breeding, feeding, and cover
San Joaquin kit fox *(Vulpes macrotis mutica)*	E/T	Portions of western Kern, eastern San Luis Obispo, western Tulare, Kings, western Fresno, western Merced, western Stanislaus, southwestern San Joaquin, Alameda, Contra Costa, Santa Clara, San Benito, Monterey, and extreme northern Santa Barbara Counties	Grasslands, saltbush, open woodlands, and alkaline sink valley floor	Kellogg Creek watershed: Kit foxes observed in several locations; one known breeding pair Conveyance facilities: Potential habitat in annual grasslands on the western side of San Joaquin Valley	Habitat loss is the major factor; also road kills, shooting, poisoning, and predation by coyotes
Ringtail *(Bassariscus astutus)*	–/CP	Throughout most of California	Dens among boulders or in hollows of trees in riparian forests, oak woodlands, and coniferous forests	Kellogg Creek watershed: Potential habitat; DFG found a potential scat during the 1980-1982 study Conveyance facilities: No suitable habitat	Loss of riparian habitats
American badger *(Taxidea taxus)*	–/SSC	Throughout California except coastal forests and cultivated agricultural lands	Grasslands and oak savannas	Kellogg Creek watershed: Several observed during field surveys; dens were located along several Vasco Road relocation alternatives Conveyance facilities: Potential habitat in grasslands	Loss of lowland grassland habitats; deliberate killing; direct and secondary poisoning from rodent and predator poisoning; badger control programs

Species	Legal Status[a] Federal/State	Distribution	Preferred Habitat	Occurrence in the Project Area	Reasons for Decline
Mule deer (*Odocoileus hemionus*)	--/--*	Throughout California	Coniferous forests, oak woodlands, meadows, riparian habitats, and scrub habitats	Kellogg Creek watershed: Resident deer occur primarily in chaparral and oak woodland habitats; also in lower numbers in savannas and riparian areas Conveyance facilities: No suitable habitat	Loss of habitat and human disturbance

[a] Status explanations:

Federal

E = listed as endangered under the federal Endangered Species Act (50 CFR 17.11).

T = listed as threatened under the federal Endangered Species Act (50 CFR 17.11).

C1 = Category 1 candidate for federal listing. Category 1 includes species for which USFWS has on file enough substantial information on biological vulnerability and threat to support proposals to list them (54 FR 554, January 6, 1989).

C2 = Category 2 candidate for federal listing. Category 2 includes species for which USFWS has some biological information indicating that listing may be appropriate but for which further biological research and field study are usually needed to clarify the most appropriate status. Category 2 species are not necessarily less rare, threatened, or endangered than Category 1 species or listed species; the distinction relates to the amount of data available and is therefore administrative, not biological (54 FR 554, January 6, 1989).

1R = recommended for Category 1 status (White pers. comm.).

2R = recommended for Category 2 status (White pers. comm.).

State

E = listed as endangered under the California Endangered Species Act (14 CCR 670.5).

T = listed as threatened under the California Endangered Species Act (14 CCR 670.5).

CP = fully protected under the California Fish and Game Code (Cal. Fish and Game Code, Sections 3511, 4700, 5050).

SSC = species of special concern (Remsen 1978 and Williams 1986).

* = species of special interest tracked by DFG or NDDB.

Section C-4. Information on Special-Status Wildlife Species That Occur in the Project Area

SAN JOAQUIN KIT FOX

Background

Before 1930, the kit fox's known range extended from Contra Costa and San Joaquin Counties in the north to Kern County in the south (Grinnell et al. 1937). A comparison of more recent survey efforts (Jones & Stokes Associates 1989, 1990, 1991f; Hall 1983; Orloff et al. 1986; Stromberg and Schmoldt pers. comms.) with those from Swick (1973) indicates that kit fox populations have declined substantially in the northern portion of the range in recent years. Except for an observation in 1982 (Palmisano pers. comm.), the San Joaquin kit fox had not been observed in Contra Costa County since 1973, before Jones & Stokes Associates' 1987 studies.

The San Joaquin kit fox inhabits arid grasslands, alkali sinks, and open oak woodlands of the San Joaquin Valley and surrounding foothills (U.S. Fish and Wildlife Service 1983). In the northern portions of its range, the kit fox occurs primarily in foothill grasslands (Orloff et al. 1986).

Kit foxes use burrows for resting, cover, and breeding. In the northern portion of their range where soils are difficult to dig, kit foxes mostly use burrows dug by other animals (Orloff et al. 1986), natural holes in drainages, and possibly culverts (Jones & Stokes Associates 1989b). Transient dens are used throughout the year, while natal dens are used only during the breeding and pupping season from December through May (Morrell 1972, U.S. Fish and Wildlife Service 1989). Natal dens can usually be distinguished by the presence of scat, prey remains, and matted vegetation around the entrances. Occupation of transient dens is often impossible to determine from den observation.

Kit foxes feed primarily on small mammals such as mice, kangaroo rats, rabbits, and ground squirrels. The prey remains most often found in scats collected in the northern portion of kit fox range belonged to the California ground squirrel (Hall 1983, Jones & Stokes Associates 1990).

Reasons for Decline

Habitat loss is the primary cause of decline of the San Joaquin kit fox in the northern portion of its range. Most of the preferred valley bottom grassland and alkali scrub habitats in the northern range have been eliminated by agricultural, suburban, and industrial development (U.S. Fish and Wildlife Service 1983). Direct poisoning and prey reduction were also suggested as major factors limiting kit fox occurrence in the remaining northern portion of its range (Orloff et al. 1986). Other factors that may affect San Joaquin kit fox populations include road kills, illegal shooting, trapping, lack of adequate denning sites, and interspecific competition with and predation by coyotes and red foxes.

Current Status in the Project Area

San Joaquin kit fox surveys were conducted in the Kellogg Creek watershed and Herdlyn area from 1987 to 1991 and on adjacent lands in corridors considered for relocation of Vasco Road. Study objectives were to determine the occurrence and distribution of the San Joaquin kit fox within the area and assess habitat suitability. Surveys along water conveyance pipeline and utility relocation alignments outside of the Kellogg Creek watershed were at the reconnaissance level only (i.e., potential habitat was assessed with aerial photographs and site visits). Three major techniques were used to determine the presence of kit foxes: scent stations, spotlight surveys, and den searches. Table 1 summarizes kit fox survey intensity and results from 1987 through 1991. Survey intensity is shown for three distinct survey efforts (Jones & Stokes Associates 1989b 1990, 1991f).

Habitat factors that may influence kit fox distribution and abundance in the Kellogg Creek watershed include habitat type, topography and den site availability, prey base and rodenticide effects, land use, and predators and competitors (Jones & Stokes Associates 1989b). An evaluation of habitat suitability was necessary because the area contains suitable unoccupied habitat, and impacts on potential habitat could be considered significant if they could affect the future recovery of the species.

Using information from all three survey techniques, Jones & Stokes Associates has concluded that few kit foxes are present in or near the Kellogg Creek watershed. Despite intensive surveys over a large area, kit fox sightings were limited to a few areas in and adjacent to the watershed. Most sightings were observed in the Herdlyn area. A natal den with at least three pups was located in this area during 1989 (Jones & Stokes Associates 1991f), and individuals, but no natal den, were seen in the same area in 1990 (Jones & Stokes Associates 1991f). Several additional sightings were made outside the watershed along the proposed Vasco Road alignment (Jones & Stokes Associates 1990), and in 1988 one kit fox was seen in Round Valley.

Jones & Stokes Associates established that a 1-mile radius based on mean home range size from a kit fox observation would be used to assign occupied and unoccupied conditions. These criteria were developed based on the experience of Jones & Stokes

Table 1. Summary of San Joaquin Kit Fox Survey Effort and Results for the Kellogg Creek Watershed, including the Los Vaqueros Reservoir Inundation Zone and Vasco Road Relocation Alignments, from June 1987 through January 1991

Method	Survey Period	Survey Area	Extent of Effort	Results
Scent station surveys	November-December 1987 and July-August 1988	Kellogg Creek watershed and Herdlyn area	17 scent stations for 27 scent-station nights	One scent station with San Joaquin kit fox tracks in Herdlyn area
	April 1990-January 1991	Vasco Road relocation alignments	48-53 scent stations for 459 scent-station nights	None
	February-September 1989	Los Vaqueros Reservoir inundation zone	33-35 scent stations for 311 scent-station nights	None
Nighttime spotlighting	June 1987-August 1988	Kellogg Creek watershed and Herdlyn area	51 survey nights, 158 survey hours, 1,064 survey miles	15 observations in Herdlyn watershed (includes one observation in Round Valley)
	April-September 1989	Vasco Road relocation alignments	14 survey nights, 20.5 survey hours, 100 survey miles	Two observations on modified County Line Alignment
	October 1988-September 1989	Kellogg Creek watershed, Los Vaqueros Reservoir inundation zone, and Herdlyn area	17 survey nights, 51 survey hours, 375 survey miles	Three observations in Herdlyn area (none observed in Los Vaqueros Reservoir inundation zone)
Den surveys	June 1987-August 1988	Kellogg Creek watershed and Herdlyn area	5,900 acres surveyed	Total - 107 potential dens, 16 possibly active dens, six active dens; Herdlyn area - 78 potential dens, 11 possibly active and six active dens
	April 1989-January 1991	Vasco Road relocation alignments	278.5 acres surveyed for all road alignments, 141.5 acres for County Line Alignment	All road alignments - 93 potential dens, 21 possibly active dens; modified County Line Alignment - 46 potential dens, seven possibly active dens
	July-August 1989	Kellogg Creek watershed and Herdlyn area (includes 1,200 acres in Los Vaqueros Reservoir inundation zone)	1,415 acres surveyed	Total - 24 potential dens, four possibly active dens; Los Vaqueros Reservoir inundation zone - 19 potential dens, one possibly active den

Associates biologists; discussions with DFG, USFWS, and other biologists that have studied kit fox; and review of literature on the life history and habitat requirements of the kit fox and other fox species that occupy the watershed.

Based on the results of surveys and application of occupancy criteria, Jones & Stokes Associates biologists concluded that much of the suitable kit fox habitat in the project area was not occupied by the San Joaquin kit fox. DFG and USFWS biologists concurred with this interpretation (Wilcox and Kanim pers. comm.), but recently USFWS staff have applied stricter criteria by which most of the suitable habitat is considered occupied (Simons pers. comm.). USFWS considers to be occupied all suitable habitat within 2 miles of a known den or pupping dens or areas where other evidence of occurrence exists, such as a fox scat. In addition, USFWS recommended that lands acquired for habitat compensation would have to be of similar type (i.e., within 2 miles of a sighting or scat).

The difference in interpreting occupied habitat reflects different approaches to the issue of occupancy criteria. Jones & Stokes Associates' view is that the presence of fox scats (which cannot be identified to species at this time) found away from areas of kit fox sightings and near areas occupied by red or gray foxes should not cause an area to be considered occupied. In contrast, USFWS contends that, because fox scats cannot be identified to species, any scats not strictly associated with a red or gray fox sighting should be considered a kit fox scat. In addition, USFWS uses a greater distance from kit fox sightings to designate occupied habitat. In this report impacts on occupied habitat are presented using both of USFWS's 2-mile criterion.

All kit fox observations were made in areas of extensive grassland habitat. Although most of the grasslands in the eastern portion of the watershed area are on moderate to steep terrain, the presence of a successful natal den in such habitat (Jones & Stokes Associates 1989b) suggests that other steep grasslands in the area are also suitable. The survey results indicate that all the grassland habitats (including valley oak savanna and alkali wetlands) in the project area are suitable kit fox habitat. In total, about 66% (11,250 acres) of the Kellogg Creek watershed and relocated Vasco Road are considered suitable for the kit fox based on acres of oak savanna and grassland habitat. Approximately half of the 11,250 acres are considered occupied based on the criterion of 2-miles from a fox sighting, while all of the 11,250 acres are considered occupied based on the criterion of 2-miles from an unidentified fox scat. No kit foxes were sighted in or near chaparral, dense oak woodlands, or agricultural or dryland farmed habitats. Chaparral, dense oak woodland, and agricultural lands are not considered suitable kit fox habitat. Dryland farmed areas are considered marginal habitat because frequent ground disturbance reduces prey numbers and eliminates potential den sites. Dryland farmed habitat may be considered occupied, however, if it supports prey populations and is within 2 miles of a sighting or scat.

Dens were classified as potential dens if the opening was 4 to 10 inches in diameter for its entire visible length, possibly active dens if they were the right size (4-10 inches) and showed signs of recent activity that might indicate kit fox use, and active dens if kit fox were observed at the dens. A total of 224 potential dens, 41 possibly active dens, and six active dens were found within the 7,600 acres surveyed (Table 1). Most potential and possibly active dens were associated with ground squirrel colonies. The low number of potential

dens for an area this size does not indicate that the quality of the habitat is low; many additional ground squirrel holes that were too small to be classified as potential dens could readily be made suitable by kit foxes.

In addition to providing potential den sites, California ground squirrels are the major prey of the kit fox in the watershed (Jones & Stokes Associates 1991c) and elsewhere in the northern portion of the kit fox range (Hall 1983, Orloff et al. 1986). Previous workers indicated that few ground squirrels occurred on watershed lands and elsewhere in Contra Costa County as a result of an extensive poisoning campaign in the 1970s and early 1980s. Elimination of the ground squirrel prey base through poisoning and the direct effects of poisoning kit foxes (discussed below) are believed to have been largely responsible for the reduced kit fox population in the northern portion of its range (Orloff et al. 1986).

Recent surveys have shown that the squirrel population in the watershed has recovered and is now abundant (Jones & Stokes Associates 1989b, 1991c), presumably as a result of recent relaxation of intensive, large-scale poisoning campaigns. Studies conducted to determine the effects of livestock grazing intensity on squirrel populations indicated that squirrels were abundant in all grazed areas, but slightly more abundant in heavily grazed areas (Jones & Stokes Associates 1991c). Squirrels were absent, however, from grassland areas where grazing had been excluded. Major ground squirrel concentrations were present in many areas that were not occupied by the kit fox, suggesting that prey availability is not limiting kit fox abundance and distribution.

Kit foxes are susceptible to secondary poisoning by rodenticides, such as 1080 and anticoagulants, especially in the northern portion of their range where California ground squirrels are their principal prey. A kit fox reportedly died of diphacinone (an anticoagulant) poisoning in Bakersfield in 1987 (Huffman and Murphy in press). Anticoagulants (which do not require a permit for application, as does 1080) were used by private landowners to control high ground squirrel populations on watershed lands. The treated area included the 1989 natal den area and Brushy Creek area along relocated Vasco Road.

Land use impacts on kit fox habitat suitability vary depending on the type of use. Regular discing of dryland farmed habitat has rendered some areas unsuitable for denning by kit foxes, although these areas may retain some foraging value between the spring harvest and fall planting. Windfarm development and operations appear to be compatible with maintenance of kit fox populations despite some habitat loss (Hall 1983, Jones & Stokes Associates 1989b). Livestock grazing also does not appear to be detrimental to kit fox habitat; some grazing appears to be required to maintain ground squirrel populations (Jones & Stokes Associates 1991c).

Coyotes and red foxes were present throughout the eastern portion of the Kellogg Creek watershed and Herdlyn area and were frequently seen in the same areas as kit foxes. Coyotes and gray foxes were also found in the western portion of the watershed. Coyotes and red foxes were always associated with grasslands. Coyotes often prey on kit foxes; the red fox, which probably colonized the watershed lands in the 1960s or 1970s (Gray 1977), may be a predator and a competitor with the kit fox. Gray foxes were observed in chaparral and oak woodland habitats in the western portion of the watershed that are too densely vegetated to be suitable for the kit fox; therefore, the gray fox does not pose a threat to kit foxes.

In summary, although kit fox numbers appear to have declined in Contra Costa County since surveys in the late 1960s and early 1970s (Swick 1973) Jones & Stokes Associates studies confirm the presence in Contra Costa County of the kit fox. The analysis of potential limiting factors suggests that expansion of the kit fox population to unoccupied suitable habitats within the project area may be inhibited by the current low population density, which may have resulted from past squirrel poisoning efforts. The substantial prey base and number of potential den sites in the project area appear sufficient to support more kit foxes than are currently present.

Immigration to and reproduction of kit foxes within the area may be insufficient to permit substantial population expansion in the project area. Maintenance of this and other scattered northern populations may depend on maintaining opportunities for dispersal between sites in Alameda and San Joaquin Counties. Predation by and competition with coyotes and red foxes could also be restricting population growth in the project area and other areas.

GOLDEN EAGLE

Background

Golden eagles feed mainly on rabbits and California ground squirrels. Pairs typically nest in cliffs or trees, preferably near grasslands where prey are available. In the Kellogg Creek watershed area, some golden eagle pairs use the same nest each year while others move nest sites (Jones & Stokes Associates 1989b, 1991f).

Reasons for Decline

The golden eagle was once a common permanent resident throughout open areas of California but their numbers are now reduced near human population centers. Prey species abundance can strongly affect habitat suitability for golden eagles (Murphy 1975). Urban encroachment, including wind turbine development, reduces habitat suitability and increases mortality (Estep 1989, BioSystems Analysis 1991).

Current Status in the Project Area

Surveys were conducted for nesting golden eagles at potential nesting cliffs and in oak woodlands. All trees within the reservoir inundation zone and along the road alignments were searched during the nesting season for nesting pairs and large stick nests. Complete surveys were not conducted on watershed lands, but nests were searched for in areas where

eagles were often seen and elsewhere during other work. Foraging habitat quality was determined by mapping ground squirrel abundance in grasslands.

Impacts on wintering and breeding habitat requirements for the golden eagle were assessed using a habitat suitability index (HSI) model developed by Jones & Stokes Associates, for golden eagles in the interior central Coast Ranges of California. HSI nesting and foraging habitat variables were used to determine preproject and postproject habitat quality of the watershed.

Nesting suitability was determined by three factors: the presence of suitable nest sites, the proximity to suitable foraging areas, and the distance of potential nests from human disturbance. Foraging area suitability was determined from vegetation consitons including percent grass cover, percent shrub/tree/rock outcrop cover, and average grass height, and distance from human disturbance.

Three nesting pairs and a probable fourth pair were located in the watershed area. The areas around the nest sites were designated as territories 1, 2, and 3. Territory 4 designates the area where the probable nesting pair of adults was seen near an historical golden eagle nest and an unoccupied stick nest; however, no active nest was found in territory 4. The density of nest territories in the project area indicates that a healthy eagle population remains. All nests found during 1988-1991 were in oak trees. Neither of the suitable rock outcrops were active.

Ground squirrels, the major prey species of golden eagles, were widespread in most of the annual grasslands in the watershed area. Low numbers of ground squirrels were observed in dryland farmed areas after the crops were harvested and the ground disced.

The Los Vaqueros Reservoir and Kellogg Reservoir inundation zones appear to receive moderate to heavy use for foraging by golden eagles. All the annual grasslands in the inundation zones are suitable foraging habitat because suitable nest sites are available nearby and the level of human disturbance is low. Dryland farmed habitat represents low- to moderate-quality foraging habitat because seasonal ground disturbance reduces ground squirrel abundance.

Preproject habitat suitability for golden eagles is considered high because of the presence of active nests and the frequent sightings of foraging golden eagles. Potential next sites are abundant throughout the watershed. Most of the watershed is considered suitable for foraging by golden eagles based on the number of acres of open grassland, interspersed with oak woodlands and chaparral for perch sites, and the low to moderate grass height that sustains large populations of ground squirrels. The low level of human disturbance on most watershed lands enhances its suitability as foraging habitat. Details concerning historical and current factors that have influenced ground squirrel abundance are discussed by Jones & Stokes Associates (1989b).

PRAIRIE FALCON

Background

The prairie falcon prefers ledges of cliffs with potholes and caves for its nest scrapes and sometimes uses old raven or red-tailed hawk cliff nests (Terres 1987). At one time, the prairie falcon was a common permanent resident throughout most of California (Grinnell and Miller 1944) but the species has declined in some areas. Potential threats to the prairie falcon include pesticide contamination, human disturbance at nest sites, and a decline in prey species abundance (Murphy 1975, Remsen 1978).

Current Status in the Project Area

Nest surveys were conducted for the prairie falcon at suitable cliff sites. Prairie falcons were also observed during other wildlife surveys.

In 1988, a pair of prairie falcons attempted to breed at one of the rock outcrops near the watershed (Jones & Stokes Associates 1989b). The falcons abandoned their breeding attempt for undetermined reasons and did not attempt to renest them in 1989. Another cliff in the Kellogg Creek watershed has reportedly been used intermittently for nesting by prairie falcons since the 1940s (Beeman pers. comm.). Several lone prairie falcons were sighted in the watershed grasslands and wind turbine areas (Jones & Stokes Associates 1989b, 1991f).

The grasslands and other open habitats in the project area are suitable foraging habitat for prairie falcons. Horned larks and ground squirrels, frequent prey species, are abundant in the project area (Murphy 1975). Potential nest sites for the prairie falcon are found on rock outcrops in the southwestern and southeastern portions of the watershed. The location of the known nest site is not illustrated because nest sites are sensitive to human disturbance. No suitable cliff nest sites are located within the inundation zone of either the Los Vaqueros or Kellogg Reservoir sites.

BURROWING OWL

Background

The burrowing owl breeds and roosts in burrows, especially in abandoned ground squirrel colonies. Burrowing owls often nest in roadside embankments, on levees, and along irrigation canals. Burrowing owls prefer open, dry, and nearly level grassland or prairie habitat (Grinnell and Miller 1944). Burrowing owl populations have declined in California

as a result of ground squirrel control measures and the conversion of grasslands to agricultural and urban uses (Remsen 1978).

Current Status in the Project Area

Surveys were conducted for burrowing owls in 7,600 acres of grassland habitats during surveys for kit fox dens and during other wildlife work. Surveys recorded sightings of burrowing owls and burrows that showed evidence of owl use (i.e., feathers, pellets, or whitewash).

Burrowing owls and their signs were observed at several locations on the eastern half of the watershed, in California ground squirrels colonies. Several burrowing owls were observed near the south end of the relocated Vasco Road alignment.

Burrowing owls appear to be uncommon in the watershed area. Their infrequent occurrence is unexpected because the general habitat conditions in the area appear suitable for the species. The burrowing owl population has probably been reduced through direct mortality and historical reduction of ground squirrels populations caused by squirrel-poisoning efforts, which may have reduced the numbers of burrow sites.

ALAMEDA WHIPSNAKE

Background

The Alameda whipsnake is found sporadically throughout Alameda and Contra Costa Counties, usually in association with large stands of northern coastal scrub or chaparral, but may occur in any inner Coast Ranges plant community, including in grasslands, open woods, on rocky slopes, and along open streams and arroyos.

Reasons for Decline

Alameda whipsnake habitat has been greatly reduced due to urban and residential development and water impoundment projects.

Current Status in the Project Area

Alameda whipsnakes were common in undisturbed portions of its preferred habitat on the western half of the Kellogg Creek watershed during DFG's 1983 surveys. In late

1988, a potential quarry site in the watershed with suitable habitat for the whipsnake was intensively studied by Dr. Sam McGinnis, an expert on this species. (For more information see Jones & Stokes Associates 1991f.)

Sixteen Alameda whipsnakes, both young and adults, were captured or observed during the 9-month trapping period.

Based on the results of this and previous studies, suitable Alameda whipsnake habitat occurs in the western portion of the Kellogg Creek watershed that has chaparral, rock outcrops, and oak woodlands. The Los Vaqueros Reservoir and Kellogg Reservoir inundation zones do not support suitable Alameda whipsnake habitat.

Habitat quality for the Alameda whipsnake in the potential quarry area is considered to be higher than that of any area previously surveyed (Jones & Stokes Associates 1991f, McGinnis pers. comm.). Based on these findings, CCWD chose to pursue other options for obtaining dam construction materials.

CALIFORNIA RED-LEGGED FROG, CALIFORNIA TIGER SALAMANDER, WESTERN POND TURTLE

Background and Reasons for Decline

The region supports several special-status amphibians and reptiles, including the California red-legged frog, California tiger salamander, and western pond turtle. The distribution and abundance of all three species have been substantially reduced in California.

California red-legged frogs use permanent aquatic habitats, such as streams and ponds (Stebbins 1985). Adults are highly aquatic when active but are less restricted to permanent water than other frog species (Brode and Bury 1984); adults may estivate during dry periods in rodent holes or cracks in the soil (Hansen pers. comm.). California red-legged frog populations have declined in California because of habitat destruction and competition and predation by the introduced bullfrog and fish species (Moyle 1973).

Adult tiger salamanders are terrestrial and spend most of the year in underground burrows, emerging for only brief periods to breed (Stebbins 1985). Breeding occurs in temporary and permanent waters in grassland and open woodland habitats (Stebbins 1985). Individuals may travel as far as 1 mile to breeding sites during the first heavy rains, mainly from December to February (Stebbins 1985, Brode pers. comm.). The range of the California tiger salamander has been reduced in much of the Central Valley because of conversion of grassland habitats to agricultural and urban uses (Stebbins 1985).

The project area is in an area of intergradation between the southwestern and northwestern pond turtle subspecies. Only the southwestern subspecies is a species of

special concern. USFWS is considering new information regarding the taxonomic status and may drop the subspecies designation and consider all western pond turtles as candidate species (Brewer pers. comm.). The southwestern subspecies' range extends south along the California coast from the Bay to Baja California (Stebbins 1985). The pond turtle is thoroughly aquatic, preferring the quiet waters of ponds, reservoirs, and sluggish streams (Stebbins 1954). However, upland habitat is required for nesting turtles, and the pond turtle may travel 0.25-0.5 mile upslope from a permanent water source to lay its eggs in grassland habitats (Brewer and Brode pers. comms.). Populations of the southwestern pond turtle have declined because of loss of acquatic habitat to agricultural development, water diversion, stream channelization, and urbanization.

Current Status in the Project Area

Watershed area water bodies, including stock ponds and creek and ditch sites, were surveyed for special-status reptiles and amphibians during spring 1988, 1989, 1990, and 1991. Three sampling techniques were used: visual, dip-net, and seine surveys. (See Jones & Stokes Associates 1989b, 1991f for a detailed description of survey techniques.) Sampling periods coincided with several years of a 5-year drought.

California red-legged frogs were found in stock ponds scattered throughout the watershed (Jones & Stokes Associates 1989b and 1991f). DFG (1983) reported the species to be abundant at almost all areas in the Kellogg Creek watershed with permanent, slow-moving water and heavy aquatic vegetation. DFG also reported red-legged frogs in Brushy Creek along the County Line Alignment (Brode pers. comm.). Jones & Stokes Associates (1989b) also observed this species in ponds with no vegetation. The drought may have reduced the numbers of breeding amphibians, which may explain why DFG (1983) previously found greater numbers of California red-legged frogs and California tiger salamanders in the watershed. DFG's survey periods coincided with several years of above-average rainfall.

Tiger salamander larvae were found only in four ponds with submergent vegetation by Jones & Stokes Associates (1991f). In addition we found California tiger salamander in three stock ponds south of the watershed during Vasco Road relocation surveys (Jones & Stokes Associates 1990). A previous study in the Kellogg Creek watershed reported large salamander populations in creeks and ponds (California Department of Fish and Game 1983).

Western pond turtles were observed in several locations along Kellogg Creek and in one stock pond. DFG (1983) reported a large population of this species in standing and flowing water in the north half of the watershed.

All stock ponds and major creeks within the watershed area are considered potential habitat for California red-legged frogs, California tiger salamanders, and western pond turtles. Brushy and Kellogg Creeks maintain some water year round in a few scattered pools. Where permanent pools exist, Brushy and Kellogg Creeks provide habitat for western

pond turtles. Brushy and Kellogg Creeks are suitable habitat in normal rainfall years for California red-legged frogs, and possibly California tiger salamanders if the water is slow moving. Most stock ponds in the area, however, are unsuitable for the pond turtle because they are intermittent and the amount of submergent and emergent vegetation is limited.

Irrigation ditches occur outside the watershed near project conveyance alignments and provide marginal habitat because they are intermittent and, when flowing, support deep, fast-moving water. Some ditch-side seeps may be suitable habitat for California red-legged frogs.

Moderate to heavy cattle use at most of the water bodies limited the amount of aquatic vegetation, thus limiting the habitat suitability for the amphibians.

CURVE-FOOTED HYGROTUS DIVING BEETLE

Background

The curve-footed hygrotus diving beetle is a rare California beetle that until 1988 was known only from one pond near Oakley in Contra Costa County, California.

Current Status in the Project Area

Surveys were conducted for curve-footed hygrotus diving beetles in the region at ponds, flowing streams, drying pools in intermittent streams, roadside ditches, irrigation canals, alkali wetlands, and a metal stock trough.

Curve-footed hygrotus diving beetles were found in water bodies throughout the region. The highest populations were found in a stock pond, creek pools, and alkali wetlands near the northeast portion of the watershed on the County Line Alignment. Most occupied waters had alkaline characteristics.

Project surveys increased the known curve-footed hygrotus diving beetle sites from one to 23 and expanded its range approximately 12 miles south from Oakley to Alameda County. Most water bodies within the region are assumed to be potential habitat for the curve-footed hygrotus diving beetle.

BAY CHECKERSPOT BUTTERFLY

Background

The bay checkerspot butterfly is a federally threatened subspecies of Edith's checkerspot. Luesther's checkerspot, an unlisted subspecies of Edith's checkerspot, can also occur with the bay checkerspot. The bay checkerspot butterfly typically is found on serpentine outcroppings along the San Francisco peninsula and on the hills south of San Jose, California. The species has declined throughout its range as a result of urban development, livestock grazing, and drought effects. The bay checkerspot was also known to occur along Morgan Territory Road near the Kellogg Creek watershed where no serpentine outcrops exist.

Reasons for Decline

The Morgan Territory colony was thought to have become extinct during the drought in the late 1970s (Ehrlich et al. 1980).

Current Status in the Project Area

Surveys were conducted in potential checkerspot habitat in the Kellogg Creek watershed in spring 1988 and 1989. Survey objectives were to determine if the bay checkerspot occurred in the watershed and to characterize the distribution and habitat of both Edith's checkerspot subspecies in the watershed. Ecological characteristics, such as food plants and flying time, were used in conjunction with wing color pattern to distinguish subspecies of Edith's checkerspot. (Jones & Stokes Associates 1989b, 1991g).

No populations of the bay checkerspot butterfly were found, although many areas in and near the watershed support abundant food plants typically used by the subspecies.

Adult and larval Luesther's checkerspot butterflies were observed at several locations within the watershed area. Observation of larva feeding on typical Luesther's food plants and the late-spring adult flying time indicated the subspecies was Luesther's checkerspot. Approximately half of the individuals examined, however, had wing patterns similar to the bay checkerspot while the other half corresponded with the description of Luesther's checkerspot, suggesting that some hybridization of the two subspecies has occurred. Pure strains of the bay checkerspot are probably extinct within and near the Kellogg Creek watershed.

FAIRY SHRIMP

Background

California has 17 species of fairy shrimp, of which six are endemic to California. Fairy shrimp live in ephemeral, freshwater aquatic habitats. They depend on cyclical environmental fluctuations, including water, pH levels, salinity, temperature, and quantities of dissolved oxygen. Many species of fairy shrimp appear to have only one generation, which emerges early, produces resting eggs, and then dies (Zedler 1987). The eggs oversummer in a resistant egg stage and proceed through development to hatch in the next wet season when the required chemical and temperature levels in their aquatic habitat are reached (Zedler 1987, Eng et al. 1990).

Reasons for Decline

Much of the fairy shrimp habitat in California has been lost through urban, agricultural, water, and energy development (Eng et al. 1990).

Current Status in the Project Area

DFG (1983) conducted extensive surveys for fairy shrimp species in the watershed. Recent surveys were limited to rock outcrop pools and grassland pools outside the watershed that were not previously surveyed (Jones & Stokes Associates 1991f).

Rock outcrop pools in the vicinity of the Kellogg Creek watershed supports the highest diversity of fairy shrimp species of any known location in California, including the longhorn, vernal pool, and California linderiella fairy shrimps (California Department of Fish and Game 1983). USFWS is currently evaluating a petition to propose the longhorn, vernal pool, and California linderiella as threatened or endangered species (White pers. comm.). Two additional fairy shrimp species were found outside of the watershed: *Artemia franciscana*, which is associated with saline water bodies, and *Branchinecta lindhali*, a widely distributed species.

The longhorn fairy shrimp was previously unrecorded outside of the Kellogg Creek watershed area, but has since been found at two other locations: Joaquin Murrieta Caves at Altamont Pass and near Soda Lake in San Luis Obispo County (Eng et al. 1990). The vernal pool and California linderiella fairy shrimps also occur in grassland vernal pools in the northern Sacramento Valley.

Rock outcrop pools within the watershed area are suitable habitat for at least three species of fairy shrimp: longhorn, vernal pool, and California linderiella fairy shrimp. Suitable fairy shrimp habitat is also present in and outside of the watershed in depressions, vernal pools, and saline water bodies for more common fairy shrimp such as *B. lindahli* and *Artemia* species.

OTHER SPECIAL-STATUS WILDLIFE SPECIES

Several other special-status wildlife species have been observed infrequently or are expected to occur infrequently in the project area. Section C-3 lists these species, their habitat descriptions and geographic distribution, and known or expected occurrences in the region.

Several of these species, including the bald eagle and peregrine falcon, occur only as winter visitors. Reservoir construction will provide foraging habitat for migrating and wintering raptors such as the bald eagle, peregrine falcon, and osprey. The San Joaquin pocket mouse, American badger, ferruginous hawk, and northern harrier are widespread throughout the region, but only a small proportion of their suitable habitat occurs in the watershed. The watershed area also provides marginal habitat for the long-billed curlew and waterfowl, and represents only a small proportion of available habitat.

Several special-status species occur in marsh habitat in the Delta, including the saltmarsh yellowthroat, Suisun song sparrow, salt marsh harvest mouse, California black rail, and California least tern. Section C-3 lists other species with potential to occur on conveyance facilities.

Section D

Analyses Background, Assumptions, and Methodologies

Section D-1. Cultural Resource Sites Identified in the Los Vaqueros Project Area

Cultural Resource Sites Identified in the Los Vaqueros Project Area

Area	Archeological Site Number or Architectural Property Number	Description
Los Vaqueros Reservoir		
100,000 af	Property #19	Dwelling
	CA-CCO-427H	Partially extant ranch complex
	CA-CCO-445H	Nonextant ranch complex
	CA-CCO-449/H	Extant 1930s barn
	CA-CCO-458/H	Historical components: artifact scatter Prehistoric components: midden, artifacts
	CA-CCO-459	Milling features
	CA-CCO-468	Rock shelter, milling feature
	CA-CCO-469	Milling feature
	CA-CCO-470H	Extant circa 1934 ranch complex; site of "lower adobe"
	CA-CCO-471H	Possible location of Vasco School; no visible remains
	CA-CCO-636	Milling station, lithic scatter, possible campsite
Dam and spillway	CA-CCO-637	Sparse lithic scatter; considerable antiquity possible
Vasco Road Relocation	CA-CCO-477	Sparse lithic scatter, midden, milling features, and rock shelters
	CA-CCO-546H	Rock features, historic refuse
	CA-ALA-536H	Standing barn, collapsed outbuildings
Utility corridors		
Natural gas	CA-CCO-310	Rock shelters near the Vasco Caves

Continued

Area	Archeological Site Number or Architectural Property Number	Description
	CA-CCO-417	Rock shelters near the Vasco Caves, Native American graves
	CA-CCO-454H	Possible field camp
Watershed		
Recreational facilities	CA-CCO-9	Pecked rock art, milling features
	CA-CCO-398	No cultural materials observed in 1982 or 1987
	CA-CCO-447/H	Historical component: possible sandstone foundation Prehistoric component: possible village - housepit, pecked rock art, midden, artifacts, milling features
	CA-CCO-450/H	Historical components: extant 1930s barn, 1950s dwelling, possible foundations, mound (possibly remains of the "upper adobe") Prehistoric components: possible village - housepit, pecked rock art, midden, artifacts, milling features
	CA-CCO-452	Milling features
	CA-CCO-453/H	Cement foundation, corral
	CA-CCO-462	Pecked rock art, milling features
	CA-CCO-535H	Extant ranch complex
Increased access	CA-CCO-310	Rock shelters, milling features
	CA-CCO-399	No cultural materials observed in 1982 or 1987

Continued

Area	Archeological Site Number or Architectural Property Number	Description
	CA-CCO-417	Graves, rock shelters, middens, artifacts, milling features; previously excavated
	CA-CCO-428	Pecked rock art
	CA-CCO-434/H	Extensive and highly significant prehistoric site; several pictographs and numerous rock shelters, caves, middens, artifacts, milling features; graves probable
	CA-CCO-446H	Possible foundations
	CA-CCO-447/H	Historical component: possible sandstone foundation Prehistoric components: buried artifacts identified in 1987 (considerable antiquity possible)
	CA-CCO-450/H	See above for description
	CA-CCO-451H	Two eucalyptus groves, two water troughs, two water tanks; all dated to the 1930s
	CA-CCO-454H	Possible field camp
	CA-CCO-455	Rock shelters, milling features
	CA-CCO-456	Rock shelters, milling feature
	CA-CCO-460/H	Historical component: improvements to rock shelter Prehistoric component: rock shelters, milling feature
	CA-CCO-461	Midden, milling features, artifacts
	CA-CCO-462	Pecked rock art; milling feature

Continued

Area	Archeological Site Number or Architectural Property Number	Description
	CA-CCO-463	Midden, milling features, artifacts
	CA-CCO-464	Milling feature
	CA-CCO-465	Milling features
	CA-CCO-467/H	Historical component: extant 1930s water system; well and possible foundation Prehistoric component: numerous milling features, artifact
Fire management	CA-CCO-397	Midden, artifacts, milling feature
	CA-CCO-463	See above for description
	CA-CCO-534H	Nonextant ranch complex
	CA-CCO-560/H	Contains historical and prehistoric components: Historical: rock alignments and enclosures Prehistoric: numerous milling features, midden, artifacts
	CA-CCO-565H	Robles Stone Corral
Other	CA-CCO-6	Rock shelter, midden, milling feature
	CA-CCO-426H	Bordes Tenant Ranch
	CA-CCO-443H	Early 20th-century extant ranch complex
	CA-CCO-444H	Artifact scatter, possible structure
	CA-CCO-448H	Nonextant auxiliary ranch complex

Continued

Area	Archeological Site Number or Architectural Property Number	Description
	CA-CCO-457	Milling features, possible rock cairn
	CA-CCO-533H	Foundations, possible ranch complex
	CA-CCO-536H	Possible house site
	CA-CCO-537H	Possible house site
	CA-CCO-554	Pecked rock art, milling feature, artifacts
	CA-CCO-555	Milling features, artifact
	CA-CCO-556	Milling features
	CA-CCO-557	Milling features
	CA-CCO-558	Milling features, artifacts
	CA-CCO-559	Milling features, possible midden
	CA-CCO-561H	Nunez ranchstead; nonextant ranch complex
	CA-CCO-562H	Valenzuela homestead; nonextant ranch complex
	CA-CCO-563H	Whetfield homestead; nonextant ranch complex
	CA-CCO-564H	Stone fence
	CA-CCO-566/H	Historical component: Los Vaqueros Stone Corral; possible building platform Prehistoric components: Milling features
	CA-CCO-568	Milling feature, possible artifact
	CA-CCO-569H	Ferraro Tenant Ranch; partially extant ranch complex

Continued

Area	Archeological Site Number or Architectural Property Number	Description
Water Conveyance Alignments and Related Facilities		
Old River No. 1	CA-CCO-626H	Refuse scatter, possibly modern
	CA-CCO-631	Sparse lithic scatter
	CA-CCO-637	Sparse lithic scatter
	CA-CCO-633/H	Historical components: remains of homestead Prehistoric components: sparse lithic scatter
	20 architectural properties are estimated	
Old River No. 2	CA-CCO-621/H	Historic site with possible secondary deposition of obsidian flakes
	20 architectural properties are estimated	
Old River No. 3	CA-CCO-148/H	Historic and prehistoric components
	20 architectural properties are estimated	
Old River No. 4	No known archeological sites	
	20 architectural properties are estimated	

Continued

Area	Archeological Site Number or Architectural Property Number	Description
Old River No. 5	Possible buried prehistoric archeological site	
	Property #1, #2, #3, #8, #9, #10	Agricultural/residential complexes and dwellings
Old River No. 6	No known archeological sites	
	Property #2, #3, #8, #9, #10	Agricultural/residential complexes and dwellings
Rock Slough/Clifton Court Forebay	No known archeological sites	
	20 architectural properties are estimated	
Middle River Intake	CA-550-232H	Migrant worker's camp
Rock Slough Pipeline	CA-CCO-624H	Refuse scatter, possibly modern
Desalination plant site	CA-CCO-623H	Historic refuse scatter
Los Vaqueros pipeline	CA-CCO-463	Midden, milling features, artifacts
Kellogg Reservoir	CA-CCO-397	Midden, artifacts, milling feature
	CA-CCO-533H	Foundations, possible ranch complex
	CA-CCO-534H	Nonextant ranch complex
	CA-CCO-535H	Extant ranch complex
	CA-CCO-536H	Possible house site
	CA-CCO-537H	Possible house site

Section D-2. Assessment of Consistency of the Project Alternatives with Adopted Contra Costa County General Plan Policies

Assessment of Consistency of Project Alternatives
with Adopted Contra Costa County General Plan Policies

Policy or Implementing Measure	Alternatives: Los Vaqueros Reservoir	Kellogg Reservoir	Middle River Intake/ EBMUD Emergency Supply	Desalination/ EBMUD Emergency Supply	Explanation
Land Use Element					
Growth Management, 65/35 Land Plan, and Urban Limit Line					
3-12. Preservation and buffering of agricultural land should be encouraged as it is critical to maintaining a healthy and competitive agricultural economy and assuring a balance of land uses. Preservation and conservation of open space, wetlands, parks, hillsides, and ridgelines should be encouraged as it is crucial to preserve the continued availability of unique habitats for wildlife and plants, to protect unique scenery and provide a wide range of recreational opportunities for County residents.	C	C	C	C	All of the project alternatives have been designed to encourage preservation of agricultural and open space land, wildlife and botanical resources, wetlands, and recreational lands.
Community Identity and Urban Design					
3-86. Within Southeast Contra Costa County there is a geological deposit of domengine sandstone located just southerly of Camino Diablo and easterly of Vasco Road. This area is further discussed and mapped in the "Mineral Resources" section of the Open Space/Conservation Element.	C	C	NA	NA	The Old River No. 5 pipeline alignment under the Los Vaqueros Reservoir Alternative would cross the identified domengine sandstone deposit. This section of the deposit is not currently being mined.

Policy or Implementing Measure	Alternatives: Los Vaqueros Reservoir	Kellogg Reservoir	Middle River Intake/ EBMUD Emergency Supply	Desalination/ EBMUD Emergency Supply	Explanation
Limited residential or ranchette development of these mineral properties may be appropriate, but residential use shall be identified as secondary to mineral operations and will not be allowed to preclude the full utilization of identified mineral resources. Any nearby residential use will be permitted conditionally after recognizing the probable expansion of mineral operations and accepting the possible nuisance and inconvenience associated with mineral operations.					Because the pipeline would not be used to serve residential development in the sand mining area, and because it would not preclude full utilization of the mineral resource, siting a pipeline in this area is consistent with this policy.
Transportation					
3-90. This plan further recognizes that if a reservoir or reservoirs are built, that the Contra Costa Water District or other agencies may be required to construct additional secondary construction and access roads on these lands in order to serve their facility.	C	C	NA	NA	Although access and construction roads in the Kellogg Creek watershed are not mapped, CCWD would have to construct these facilities under the reservoir alternatives.

Policy or Implementing Measure	Los Vaqueros Reservoir	Kellogg Reservoir	Middle River Intake/ EBMUD Emergency Supply	Desalination/ EBMUD Emergency Supply	Explanation
	Alternatives				
Transportation and Circulation Element					
Bikeways					
5-L. Increase the opportunities for bicycle use in Contra Costa County for transportation as well as recreational uses.	C	NA	NA	C	The conceptual recreation plan for the reservoir alternatives includes bicycle trails.
Conservation Element					
Overall Conservation					
8-3. Watersheds, natural waterways, and areas important for the maintenance of natural vegetation and wildlife populations shall be preserved and enhanced.	C	C	NA	NA	The reservoir alternatives would inundate wetlands and oak woodlands; conceptual recreation planning under these alternatives, however, would strive to preserve wetlands and oak woodlands from construction or visitor damage. These alternatives would also inundate a substantial portion of Kellogg Creek, a natural waterway. The nonreservoir alternatives would result in a loss of wetlands, but the impact on the affected area could be less than significant. Future studies would determine the exact wetland acreage that would be lost. Refer to Chapter 7, "Vegetation", and Chapter 8, "Wildlife" for further discussion.

Policy or Implementing Measure	Los Vaqueros Reservoir	Kellogg Reservoir	Middle River Intake/ EBMUD Emergency Supply	Desalination/ EBMUD Emergency Supply	Explanation
	Alternatives				
Agricultural Resources					
8-29. Large contiguous areas of the County should be encouraged to remain in agricultural production, as long as economically viable.	C	C	C	C	CCWD's acquisition of the 20,000-acre Kellogg Creek watershed and a pipeline/intake configuration would preserve land suitable for agricultural production.
Mineral Resources					
8-56. Incompatible land uses shall not be permitted within the mineral resource impact areas identified as containing significant sand and gravel deposits. Incompatible uses are defined as land uses inherently incompatible with mining and/or uses that require a high public or private investment in structures, land improvements, and landscaping that prevent mining because of the higher economic value of the land and its improvements.	GC	C	NA	NA	The Rock Slough/Old River No. 1 configuration of the Los Vaqueros Reservoir Alternative would cross the domengine sandstone resource espansion area identified by the Unimin Corporation. This pipeline is considered inconsistent with possible future mining of this area because it would involve high public investment in structures.
Open Space Element					
Overall Open Space					
9-1. Permanent open space shall be provided within the County for a variety of open space uses.	C	C	NA	NA	The reservoir alternatives would preserve the Kellogg Creek watershed as permanent open space.

Policy or Implementing Measure	Los Vaqueros Reservoir	Kellogg Reservoir	Middle River Intake/ EBMUD Emergency Supply	Desalination/ EBMUD Emergency Supply	Explanation
	Alternatives				
Scenic Resources					
9-E. To protect major scenic ridges, to the extent practical, from structures, roadways, or other activities which would harm their scenic qualities.	C	C	NA	NA	Under the conceptual recreation plan, a dirt road located on a major scenic ridge would be reconditioned and maintained as a fire trail. This would not result in a significant scenic impact because most of the road already exists.
9-13. Providing public facilities for outdoor recreation should remain an important land use objective in the county, as a method of promoting high scenic quality, for air quality maintenance, and to enhance outdoor recreation opportunities of all residents.	C	C	NA	NA	The conceptual recreation plan would provide recreation opportunities and preserve scenic quality.
Historic and Cultural Resources					
9-28. Areas which have identifiable and important archaeologic or historic significance shall be preserved for such uses, preferably in public ownership.	C	C	C	C	Archeologic and historic sites would be adversely affected by inundation under the reservoir alternatives. However, the significance of these sites has not been determined. Significant archeologic and historic sites throughout the Kellogg Creek watershed and at other project alternative sites would be preserved.

Policy or Implementing Measure	Alternatives: Los Vaqueros Reservoir	Kellogg Reservoir	Middle River Intake/ EBMUD Emergency Supply	Desalination/ EBMUD Emergency Supply	Explanation
Park and Recreation Facilities					
9-I. To develop a system of interconnected hiking, riding, and bicycling trails and paths suitable for both active recreational use and for the purpose of transportation/circulation.	C	C	NA	NA	The conceptual recreation plan under the reservoir alternatives would add to the system of interconnected recreation trails in Contra Costa County. The nonreservoir alternatives would not affect trails.
9-J. To promote active and passive recreational enjoyment of the County's physical amenities for the continued health, safety and welfare of the citizens of the County.	C	C	C	NA	Construction of the Middle River pipeline would restrict access to a marina on Old River. However, this effect would be temporary and, therefore, consistent with this policy.
9-32. Major park lands shall be preserved to ensure that the present and future needs of the County's residents will be met and to preserve areas of natural beauty or historical interest for future generations. Apply the parks and recreation performance standards in the Growth Management Element.	C	C	NA	NA	Under the reservoir alternatives, recreation facilities would be constructed. Recreation facilities would not be constructed under the nonreservoir alternatives.
9-38. Public trail facilities shall be integrated into the design of flood control facilities and other public works whenever possible.	C	C	NA	NA	The reservoir alternatives would promote trails through the conceptual recreation area and the conveyance pipeline alignments. The nonreservoir alternatives would not affect trails.

Table 13-2. Continued

Policy or Implementing Measure	Alternatives: Los Vaqueros Reservoir	Kellogg Reservoir	Middle River Intake/ EBMUD Emergency Supply	Desalination/ EBMUD Emergency Supply	Explanation
Safety Element					
Seismic Hazards					
10-15. To the extent practicable, the construction of structures requiring a high degree of safety and other critical structures shall not be allowed in an active or potentially active fault zone.	I	I	NA	NA	Dams would be constructed in the vicinity of the Brentwood and Vaqueros faults and other smaller faults. These are active or potentially active faults. Refer to Chapter 11, "Geology, Seismicity, and Soils" for a more detailed discussion.
Flood Hazards					
10-55. The potential effects of dam or levee failure are so substantial that geologic and engineering investigation shall be warranted as a prerequisite for authorizing public and private construction of either public facilities or private development in affected areas.	C	C	NA	NA	Geotechnical and engineering studies for the Los Vaqueros Reservoir and Kellogg Reservoir Alternatives have been prepared by CCWD.

Policy or Implementing Measure	Alternatives: Los Vaqueros Reservoir	Kellogg Reservoir	Middle River Intake/ EBMUD Emergency Supply	Desalination/ EBMUD Emergency Supply	Explanation
Water Supply Requirements					
10-72. The County shall support local, regional, State, and federal government efforts to improve water quality.	C	C	C	C	Improvement of water quality is one of the main objectives of all the project alternatives.
10-75. Public ownership of lands bordering reservoirs shall be encouraged to safeguard water quality.	C	C	NA	NA	CCWD is acquiring the entire Kellogg Creek watershed.
10-82. New water storage reservoirs shall be encouraged in appropriate locations subject to adequate mitigation of environmental impacts.					

Notes: C = consistent; GC = generally consistent; I = inconsistent; NA = not applicable.

Section D-3. Transportation

METHODS AND ASSUMPTIONS USED FOR ASSESSING BASELINE TRAFFIC AND CIRCULATION CONDITION

A.M. peak-hour traffic conditions are provided to assess projected construction traffic impacts on intersections and freeway ramps in 1995, and p.m. peak-hour traffic conditions are provided to assess projected recreation traffic impacts on roadway segments in 2025.

Traffic capacity analyses were conducted for the critical facilities using standard analysis methods described in the 1985 Highway Capacity Manual (Transportation Research Board 1985).

The quality of traffic service provided by a roadway system was measured using the level-of-service (LOS) concept. This measure of the quality of traffic service assigns a letter to describe peak-period driving conditions. The letters A through F are used to describe the best to worst driving conditions, respectively. LOS A indicates free-flow operation, and LOS F denotes jammed flow with substantial delay. The characteristics of traffic flow associated with each LOS for signalized and unsignalized intersections are described in Table 1.

Signalized Intersections

For signalized intersections, the Transportation Research Circular 212 analysis procedures consider the sum of the critical lane volumes on all approaches. The resulting critical movement volume-to-capacity (V/C) ratios are applied to the entire intersection. Individual movements within the signalized intersection might, as a result, experience better conditions than indicated by the overall intersection LOS. LOS C is generally a desirable level for intersection operations, and LOS D is the minimum acceptable level for peak-period operations. Intersections operating at LOS E or F are considered unacceptable.

Unsignalized Intersections

The 1985 Highway Capacity Manual analysis procedures assess the traffic movements that conflict with movements to and from the minor street of a two-way-stop, unsignalized intersection. The minor street of such an intersection approaches a stop sign, while the major street does not have to stop at the intersection. The analysis procedures also assess

Table 1. Level of Service Definitions for Signalized and Unsignalized Intersections

	Signalized Intersection		Unsignalized Intersection	
Level of Service	Volume/Capacity Ratio	Description	Reserve Capacity	Description
A	≤0.60	Free-flow conditions; no signal phases fully utilized; no congestion	>400	Little or no delays
B	0.61-0.70	Nearly free flow with occasional flow restrictions within groups of vehicles; occasional signal phases fully utilized; little or no congestion	300-399	Short delays
C	0.71-0.80	Stable operation, drivers may feel restricted within groups of vehicles; some signal phases fully utilized, and some vehicles may have to wait through more than one signal phase; moderate congestion	200-299	Average delays
D	0.81-0.90	Approaching unstable flow with dense groups of vehicles; most signal phases fully utilized and some delays may be substantial; heavy congestion	100-199	Long delays
E	0.91-1.00	Unstable flow with nearly all signal phases fully utilized and substantial delays; long queues of vehicles may develop; very heavy congestion	0-99	Very long delays
F	>1.00	Jammed, forced-flow conditions; all signal phases fully utilized, substantial delays, long queues; actual volumes handled may be less than 100% of capacity because of jams	<0	Failure, extreme congestion

Source: Transportation Research Board 1985, Highway Research Board 1965.

the probability of adequate gaps in the traffic stream of the major street to allow minor street movements. The quantitative measure for LOS at unsignalized intersections is an estimate of the reserve capacity at the intersection. Reserve capacity is a measure of the number of additional vehicles that could pass through an intersection before it reaches capacity. The LOS and associated ranges of reserve capacity are presented in Table 1. The overall intersection LOS is determined by the turning movement with the least reserve capacity. Therefore, some movements may experience better conditions than indicated by the overall intersection LOS.

For unsignalized intersections that are controlled by four-way stop signs, current traffic analyses procedures allow only an estimate of general LOS. To analyze four-way stop intersections, analysis approaches and factors described in the 1985 Highway Capacity Manual were applied. Although V/C ratios can be estimated, the procedures used to determine the V/C ratios are relatively unsophisticated. The four-way-stop analysis procedures address approach traffic volumes, the number of approach lanes, and the percent of approach traffic volumes on the two streets.

Freeway Ramps

To be consistent with previously conducted analyses, on- and off-ramps at the Vasco Road/I-580 interchange were analyzed using capacities applied in the Livermore I-580/Route 84 traffic study (TJKM Transportation Consultants 1989). The I-580/Route 84 study assigned a capacity of 1,900 vehicles per hour per lane to diagonal ramps and a capacity of 1,650 vehicles per hour per lane to loop ramps. Applying the V/C ratio ranges shown in Table 1 to the above capacities results in the LOS ranges for freeway ramps shown in Table 2.

Two-Lane Rural Roads

In addition to the detailed intersection analysis, an LOS analysis was conducted on roadway segments throughout the study area. The two-lane road analysis applied procedures described in the 1985 highway capacity manual. Table 3 shows the LOS ranges and the corresponding V/C ratios for two-lane roadways.

The procedures described in the 1985 highway capacity manual directly address the following factors:

- peak-hour traffic volumes,
- directional split of traffic,
- lane widths,
- terrain,
- percentage of no-passing zones,

Table 2. Freeway Ramp Levels of Service

		Ranges for Volumes on Ramps (vehicles/hour)	
Level of Service	Volume/Capacity Ratio Range	Diagonal Ramps	Loop Ramps
A	≤0.60	≤1,140	≤990
B	0.61-0.79	1,141-1,330	991,-1,155
C	0.71-0.80	1,331-1,520	1,156-1,320
D	0.81-0.90	1,521-1,710	1,321-1,485
E	0.91-1.00	1,711-1,900	1,486-1,650
F	≥1.01	≥1,901	≥1,651

Source: TJKM Transportation Consultants 1989.

Table 3. Level of Service Ranges for Two-Lane Roadways

Level of Service	Volume/Capacity Ratio
A	0.15 or less
B	0.16 to 0.27
C	0.28 to 0.43
D	0.44 to 0.64
E	0.65 to 1.00
F	1.01 or more

Source: Transportation Research Board 1985.

- design speed, and
- trucks as percentage of total volume.

Because detailed information on the above factors was not available for all portions of all two-lane facilities in the study area, the procedures applied in this EIR/EIS are considered a screening-level analysis. This analysis generally focused on portions of roads most likely to be affected by the project alternatives.

Existing (1992) Traffic Volumes

The 1992 traffic volumes were projected by applying growth factors to 1989 traffic volumes. The growth factors used were based on traffic counts conducted during the last 10 years and on computer simulation traffic model studies of the project area. The growth factors were developed using a least-squares-method linear regression analysis of the historical traffic counts and traffic model projections. The growth factors were then applied to the 1989 traffic counts to extrapolate 1992 conditions.

Growth factors were developed using traffic count data collected for the Vasco Road and Utility Relocation Project EIR, traffic counts provided by Alameda and Contra Costa Counties (Whan pers. comm.), data published by Caltrans (California Department of Transportation 1989a, 1989b), data from the Contra Costa County-wide traffic model (Goetz pers. comm.), information from the Livermore Community General Plan Circulation Element (City of Livermore Planning Department 1989), and information from the Livermore I-580/Route 84 Traffic Study Report (TJKM Transportation Consultants 1989).

Growth factors were developed for individual legs of intersections, individual intersections as a whole, or for a set of intersections along a corridor, depending on the availability of traffic data. More traffic data were available for road facilities that have experienced recent increases in traffic levels.

DETAILED DISCUSSION OF CRITERIA FOR CONCLUSIONS OF SIGNIFICANCE

Initial Screening

Practices recommended by the Institute of Transportation Engineers indicate that a complete traffic impacts analysis should be prepared whenever a project might generate 100 or more additional peak-hour trips in the peak direction (Institute of Transportation Engineers 1989).

Because trucks are larger than passenger vehicles, they have longer starting and stopping periods at intersections. As a result, one truck adds more congestion than one

passenger vehicle. Based on passenger car equivalents for unsignalized intersections, one truck is counted as the equivalent of two passenger vehicles (Transportation Research Board 1985). An increase of 50 trucks, 100 passenger vehicles, or an equivalent combination of vehicles per hour during the peak hour is used as the initial threshold for determining the potential for impacts. A traffic volume increase that is less than this threshold is would be a less-than-significant impact.

LOS Analysis

Intersections or roadway segments that operate at LOS E or F are considered unacceptable (except as noted below in the "Signal Warrants" section). However, no significant impacts would be attributed to the project alternatives for intersections or roadway segments that, under the No-Action Alternative, are determined to have unacceptable LOS, V/C ratios, or reserve capacities and would maintain the same LOS with the addition of project traffic.

Signal Warrant Analysis

A preliminary signal warrant analysis was conducted on the unsignalized critical intersections. This analysis was based on established guidelines that assist in determining the need for traffic signal control (Institute of Transportation Engineers 1982, U.S. Department of Transportation, Federal Highway Administration 1983).

A comprehensive investigation of traffic conditions and physical characteristics of the intersection location is required to determine the necessity of installing a signal and to furnish necessary data for the proper design and operation of a signal that is found to be warranted. Such data are listed in the Manual on Uniform Traffic Control Devices (U.S. Department of Transportation, Federal Highway Administration 1988).

The signal warrant guidelines specify 11 criteria categories that, depending on the input variables, contribute to the need for traffic signal installation:

- minimum vehicular volume,
- interruption of continuous traffic,
- minimum pedestrian volume,
- school crossing,
- progressive movement,
- accident rates,
- systems (organization of traffic flow networks),
- combination of warrants,
- four-hour volumes,
- peak-hour delay, and
- peak-hour volume.

Fulfillment of one or a combination of the criteria in these categories may indicate that signal control is needed. The guidelines emphasize that the signal warrant criteria should be considered as only a guide for determining the need for traffic signal control in conjunction with other project-specific factors. When conditions at an intersection meet or exceed warrant criteria levels, they are an indication that signals should be considered for the location, but do not imply that signals should automatically be installed.

The analyses conducted for this study were preliminary because limited data were available. The preliminary signal warrant analysis focuses on peak-hour intersection volumes.

Unsignalized intersections with unacceptable LOS commonly do not meet signal warrants even though signalizing these intersections would improve LOS to acceptable levels. This condition commonly occurs in areas where high-volume arterials intersect with low-volume side streets; the traffic volumes along a high-volume arterial reduces intersection reserve capacities, thus reducing intersection LOS. Critical turning movements from the side streets to the arterial are difficult but contribute only minor traffic volumes that do not meet the signal warrants. Signalizing an intersection is often the only measure that would improve LOS to an acceptable level in these cases, but is inappropriate because installing a signal often improves intersection operations for only a small amount of side street traffic. The Manual on Uniform Traffic Control Devices does not recommend signalizing an intersection under these conditions because improving the operations on low-volume side streets can result in substantial interruptions to large traffic flows on major arterials, an increased potential for traffic accidents at intersections, and limited traffic improvement that does not justify the cost of signalizing the intersection.

In this analysis, for an unsignalized intersection that is projected to experience unacceptable LOS, adding approach lanes to the intersection and converting the intersection to four-way-stop control are considered as mitigation measures. If the intersection meets the peak-hour signal warrant, signalization is recommended. Signalization is not recommended if the peak-hour signal warrant is not met, even if signalization is the only measure that would result in an acceptable LOS. In addition, if signal warrants are not met at an intersection, the delay for side street traffic would be a less-than-significant impact.

Traffic Delays and Disruptions

In addition to unacceptable LOS resulting from increased truck and worker traffic, the following impacts resulting from pipeline construction would be significant:

- traffic delays or detours that would occur for more than 1 week at any location;
- detours greater than 5 miles; or
- traffic flow disruption on roads with traffic volumes greater than 15,000 average daily trips (ADT) per lane (an ADT of 15,000 is approximately the capacity of one lane of a road); rerouting a traffic flow of such volume onto surrounding

roadways would likely put the surrounding roadways over capacity; a traffic volume of 15,000 ADT per lane also is too high to channel through a reduced number of lanes without substantial delays.

RECREATION-RELATED TRAFFIC IMPACTS

Recreation-related traffic impacts would be significant if LOS along roadway segments is reduced to LOS D or worse. Impacts are assessed by adding projected p.m. peak-hour recreation traffic volumes to the projected baseline 2025 traffic volumes. P.M. peak-hour traffic conditions are used to assess recreational traffic impacts because the impact on road segments near the Kellogg Creek watershed would be greatest when weekday p.m. peak-hour commute traffic is combined with evening recreational traffic volumes. Even though recreational traffic would likely be greatest on weekends and holidays, peak background traffic volumes on weekends would be less than during weekday p.m. peak hours because commute traffic is relatively minor on weekends. For this analysis, the p.m. peak hour on Friday is assumed to produce the greatest combination of recreational and commute traffic volumes. Recreational impacts would be significant if:

- recreation-related traffic, combined with acceptable 2025 LOS conditions (without recreation traffic), would result in an unacceptable LOS on road segments or

- recreation-related traffic contributed to 2025 traffic conditions (without recreation traffic) that are projected to be unacceptable.

METHODOLOGY FOR ASSESSING IMPACTS OF DAM AND RESERVOIR CONSTRUCTION

Dam and reservoir construction under this alternative would entail transporting products, equipment, and workers to the site. The total impact of construction- related trips on each critical facility was determined by adding together the trips from each trip type. This method required that assumptions be made for the following:

- temporal distribution of construction trips,
- geographic distribution of construction trips,
- passenger car equivalency of construction vehicles, and
- peak-hour distribution of construction trips.

Temporal Distribution of Trips

Construction-related traffic impacts in this analysis are assumed to occur at a constant rate. Some materials, such as concrete, rip-rap, and filter and drain materials, would be hauled at a relatively constant rate throughout a fixed period. However, other materials, such as pipe, would be delivered intermittently over the course of the construction period.

In these cases, the average daily haul rate over the entire haul period for each material was calculated.

The number of construction worker commute trips would also vary from day to day throughout the construction period. Two types of commute impacts would occur: high-magnitude peak-hour traffic volumes that would occur intermittently for short periods and moderate commute traffic that would occur throughout the two-year construction period. This analysis assumes that long-term commute traffic occurring at a moderate level would have the greatest traffic impact because short-term peak-hour impacts would be intermittent and temporary.

Average daily construction-related commute trips were developed by determining the number of construction workers traveling to construction sites each month and selecting a period during which an average number of workers was consistently required. For the critical facilities south of the reservoir site, the combination of haul trips for filter and drain material, and worker commute trips would occur continually at a moderately high level for 18 months. For the critical facilities north of the reservoir site, the combination of rip rap haul trips and worker commute trips were assumed to occur continually at a moderately high level for the same 18-month period.

Geographic Distribution of Trips

Haul trips for various construction materials were distributed according to haul routes identified by project engineers.

The distribution of construction worker commute trips was derived based on the locations of population centers near the project area. The majority of construction worker trips were assumed to originate in Alameda and Contra Costa Counties and in Stockton and Tracy in San Joaquin County. The counties were subdivided into geographic areas to separate different routes likely to be taken to the project area. The percentage of trips originating from each of these geographic areas was then calculated based on the projected population of each area in 1995. These percentages were applied to the total number of commute trips to derive the number of commuters using each route. The 1995 population projections were obtained from the Association of Bay Area Governments (ABAG) Projections 1990 (Association of Bay Area Governments 1989).

Passenger Car Equivalency. Because the impacts of large trucks are known to be greater than the impacts of automobiles, each truck trip was counted as two passenger car trips for the purposes of LOS calculations. This estimate is consistent with Institute of Transportation Engineers standards (Institute of Transportation Engineers 1982).

Peak-Hour Distribution

Both directions of each haul trip were assumed to occur during the a.m. peak hour. For example, if 25 haul trips for concrete were expected between Livermore and the reservoir site during the a.m. peak hour, 25 trips from the reservoir site back to Livermore were also expected. For commute trips, only one direction was assumed to occur during the a.m. peak hour.

Methodology

Recreation-related traffic resulting from implementation of the conceptual recreation plan would have the greatest impact on project area roadway segments in combination with commute weekday traffic. The peak weekday recreation traffic would occur in summer during the Friday p.m. peak hour. During this peak weekday period, recreation traffic headed to the watershed and reservoir for short evening activities would be combined with recreation traffic related to longer weekend stays at campgrounds. Although average daily recreation traffic would be highest on weekends and holidays, the overall traffic during these periods would be less than at the p.m. peak hour on Friday because recreation and commute traffic would be combined. Recreation traffic impacts, therefore, are analyzed for critical roadway segments during the Friday p.m. peak hour.

The conceptual recreation plan provides approximately 190 campsites. For a worst-case analysis, each campsite is assumed to generate one vehicle, with all vehicles arriving during the p.m. peak hour. Jones & Stokes Associates conducted traffic counts at the entrance to San Pablo Dam Reservoir over a 2-week period in August 1990. Based on user trends evidenced by those counts, an additional 12% of the 2,250 total average daily recreation trips possible (based on a possible 2,250 parking spaces) are assumed to arrive during the Friday p.m. peak hour. These additional peak-hour trips involve day visits to the watershed. Total p.m. peak-hour recreation traffic would be approximately 460 trips. Trip distribution is based on the proportion of the population projected to be located within 50 road miles of the Los Vaqueros Reservoir site (Jones & Stokes Associates 1991d). The destinations of peak-hour trips are assumed to be 75% at the northern watershed entrance and 25% at the southern watershed entrance, based on the proportion of parking spaces provided in the northern and southern watershed.

Section D-4. Noise

Sound travels through the air as waves of minute air pressure fluctuations caused by some type of vibration. In general, sound waves travel away from the noise source as an expanding spherical surface. The energy contained in a sound wave is consequently spread over an increasing area as it travels away from the source. This results in a decrease in loudness at greater distances from the noise source.

Sound-level meters measure the actual pressure fluctuations caused by sound waves, with separate measurements made for different sound frequency ranges. These measurements are reported in a logarithmic decibel (dB) scale. Most sounds consist of a broad range of sound frequencies. Because the human ear is not equally sensitive to all frequencies, several frequency-weighting schemes have been used to develop composite decibel scales that approximate the way the human ear responds to noise levels. The "A-weighted" decibel scale (dBA) is the most widely used for this purpose. Typical A-weighted noise levels for various types of sound sources are summarized in Table 1.

Varying noise levels are often described in terms of the equivalent constant decibel level. Equivalent noise levels (L_{eq}) are used to develop single-value descriptions of average noise exposure over various periods of time. Such average noise exposure ratings often include additional weighting factors for annoyance potential attributable to time of day or other considerations. The L_{eq} data used for these average noise exposure descriptors are generally based on A-weighted sound-level measurements.

Average noise exposure over a 24-hour period is often presented as a day-night average sound level (L_{dn}). L_{dn} values are calculated from hourly L_{eq} values, with the L_{eq} values for the nighttime period (10 p.m.-7 a.m.) increased by 10 dB to reflect the greater disturbance potential from nighttime noises.

The community noise equivalent level (CNEL) is also used to characterize average noise levels over a 24-hour period, with weighting factors included for evening and nighttime noise levels. L_{eq} values for the evening period (7 p.m.-10 p.m.) are increased by 5 dB, while L_{eq} values for the nighttime period (10 p.m.-7 a.m.) are increased by 10 dB.

The nature of dB scales is such that individual dB ratings for different noise sources cannot be added directly to give the dB rating of the combination of these sources. Two noise or vibration sources producing equal dB ratings at a given location will produce a composite noise level 3 dB greater than either sound alone. When two noise sources differ by 10 dB, the composite noise level will be only 0.4 dB greater than the louder source alone. Most people have difficulty distinguishing the louder of two noise sources if they differ by less than 1.5-2.0 dB. In general, a 10-dB increase in noise level is perceived as a doubling in loudness. A 2-dB increase represents a 15% increase in loudness.

Table 1. Weighted Sound Levels and Human Response

Sound Source	dBA*	Response Criteria
	- 150	
Carrier deck jet operation	- 140	
		Painfully loud
	- 130	Limit amplified speech
Jet takeoff (200 feet)	- 120	
Discotheque		Maximum vocal effort
Auto horn (3 feet)		
Riveting machine	- 110	
Jet takeoff (2,000 feet)		
Shout (0.5 feet)	- 100	
N. Y. subway station		Very annoying
Heavy truck (50 feet)	- 90	Hearing damage (8 hours)
Pneumatic drill (50 feet)		
	- 80	Annoying
Freight train (50 feet)		
Freeway traffic (50 feet)	- 70	Telephone use difficult
		Intrusive
Air conditioning unit (20 feet)	- 60	
Light auto traffic (50 feet)		
	- 50	Quiet
Living room		
Bedroom	- 40	
Library		
Soft whisper (15 feet)	- 30	Very quiet
Broadcasting studio	- 20	
	- 10	Just audible
	- 0	Threshold of hearing

* Typical A-weighted sound levels taken with a sound-level meter and expressed as decibels on the scale. The "A" scale approximates the frequency response of the human ear.

Source: U.S. Council on Environmental Quality 1970.

When distance is the only factor considered, sound levels from an isolated noise source will typically decrease by about 6 dB for every doubling of distance away from the noise source. When the noise source is essentially a continuous line (e.g., vehicle traffic on a highway), noise levels decrease by about 3 dB for every doubling of distance. In traffic noise studies, a drop-off rate of 4.5 dB per doubling of distance is often used when the intervening ground between the roadway and the receiver is acoustically "soft" (e.g., ground vegetation, scattered trees, clumps of bushes).

Noise levels at different distances can also be affected by a number of factors other than just the distance from the noise source. Topographic features and structural barriers that absorb, reflect, or scatter sound waves can result in increased or decreased noise levels. Atmospheric conditions (wind speed and direction, humidity levels, and temperatures) can also affect the degree to which sound is attenuated over distance.

Echoes off topographical features or buildings can sometimes result in higher sound levels (lower sound attenuation rates) than normally expected. Temperature inversion and attitudinal changes in wind conditions can at times diffract and "focus" sound wave to a location at considerable distance from the noise source. Focusing effects are usually noticeable only for very intense noise sources such as blasting operations.